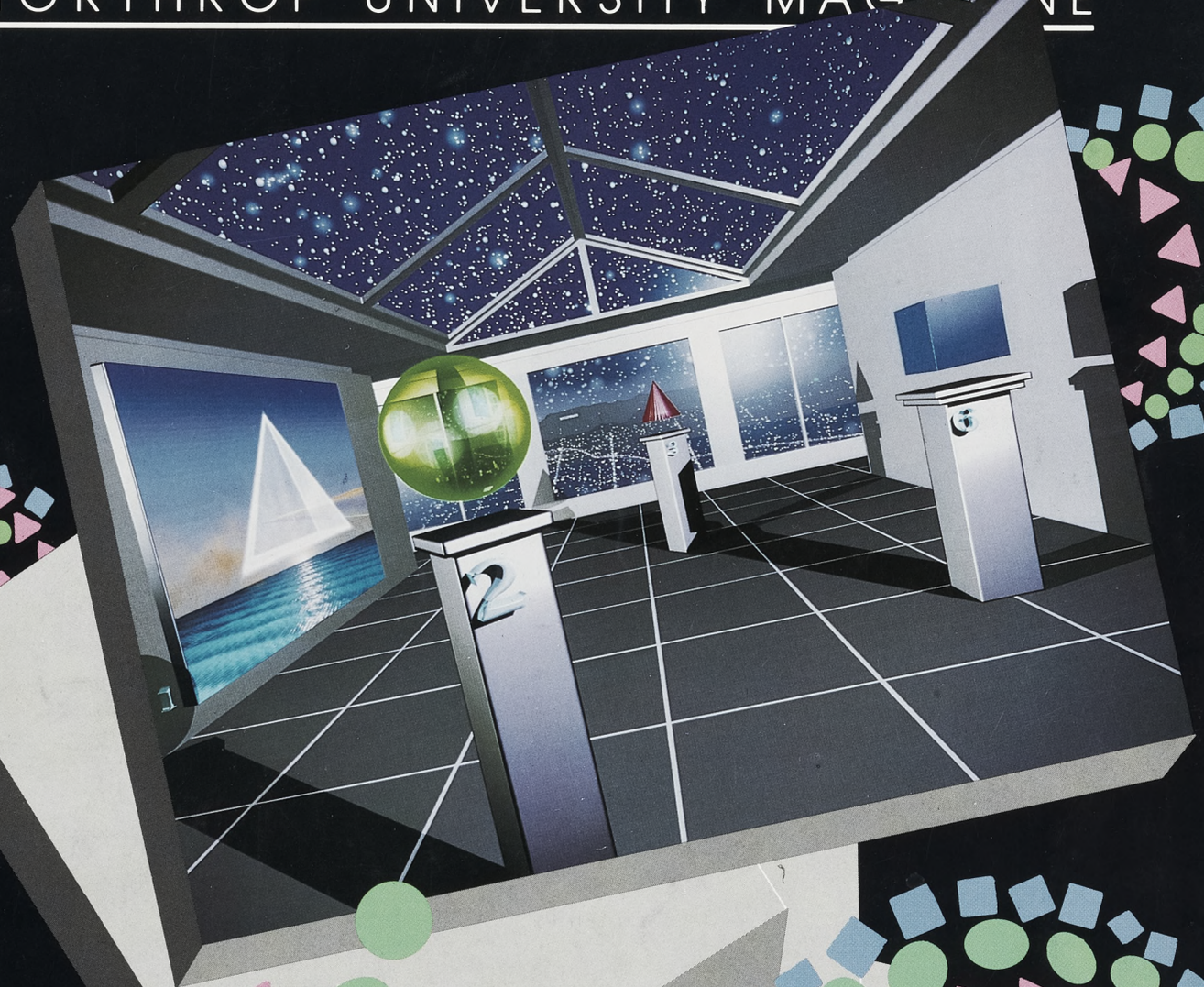
October 1982

nuance

NORTHROP UNIVERSITY MAGAZINE



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GROW WITH NORTHROP UNIVERSITY

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RTHROP UNIVERSITY MAGAZINE

Volume 3, Number 2

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Moya Lear tells the Bill Lear story

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The world's first all-graphite airplane approaches certification
by George Harrison, test pilot

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by Ruth Stroud

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General Schriever
Aviation Law Symposium
Computer Graphics Grant

of Public Relations at (213) 641-3470, ext. 340 or 275.

Inquiries

All inquiries, contributions, or requests for reprinting Nuance contents should be forwarded to: Editor, Nuance, Northrop University, Inglewood, California 90306.

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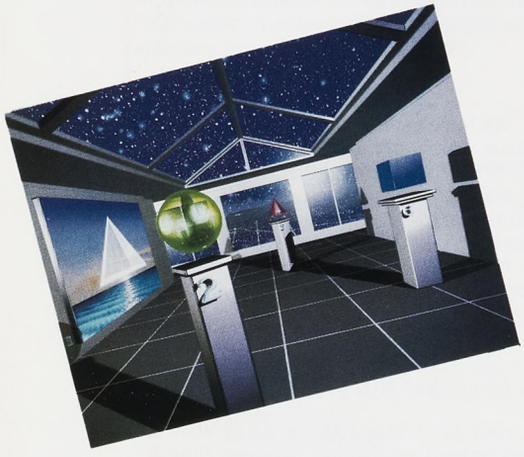

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October 1982 Volume 3, Number 2

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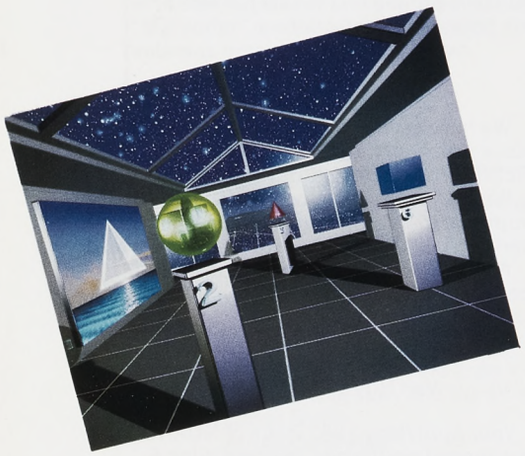

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editor's note

The age is turning. The day of the lone designer and builder, the famous single name that symbolizes success in early aviation — the Northrop, Lockheed, and Ryan of aviation are gone. This is an anonymous age. Success comes as a package deal, a network of shared expertise from concept to marketing.

Single-handed innovation is a dangerous business, not only in aviation. The challenge to entrepreneurs today seems to be in acquiring a network of skills that overlap several specializations.

The features in this issue prove, sometimes painfully, the need to apply knowledge from one specialization to the next. In "Eyeing the Energy Future," a mechanical engineer specializes in energy systems and finds his career's success leaning heavily on management and communication skills. In "Supercomputers," an electronic engineer with a background in the hardware of radar systems, finds himself on the cutting edge of programming for 3D graphics in film.

As Richard Adams points out in "Survival in the Airline Industry," the most important skill to the airline industry since deregulation is the crucial ability to market and finance air travel in today's unprotected competition.

However the characteristics of leadership vary, the one constant, at least in this issue, is the motive to excel. 'Jimmie' Doolittle put it simply. "When I was a young boy," he said, "I always wanted to achieve excellence in something and I admired Scotty Allen, the dog team racer in Nome, Alaska. He always won."

John Northrop's son, speaking at the 40th anniversary of the University, put it another way. "My father," he began, "during the last month of his illness, asked for a picture of the GOSSAMER ALBATROSS to be hung on the hospital wall where he could see it everyday."

Speaking at the same celebration, Stephen Ptacek, pilot of the SOLAR CHALLENGER, recognized the teamwork and organization behind his flight across the English Channel. "It was like trying to piece together a giant puzzle," he said. "It took a lot of skills." Yet, when it was time to dedicate the historic SOLAR CHALLENGER poster, Stephen wrote, "To Northrop University, and the Spirit of Jack Northrop."

Even in an anonymous age of package-deal success, excellence demands a proper name.

response

I read with interest the article on jet propulsion, "A Fortieth Anniversary" by Dean Welmers of the College of Engineering (NUANCE Summer/Fall 1981). However, an important segment of the turbosupercharger development was omitted in the portion entitled "Roots of the U.S. Program".

It would appear that the U.S. Air Service (later, U.S. Army Air Corps and USAF) was the pioneer in this development, beginning as early as 1920 with the turbosupercharger invented by Dr. Sanford Moss - and the experimental test flights of John A. Macready between 1920 - 1926.

Dr. Moss's experimental supercharger was installed on the specially built high altitude plane, the XCO-5 which Macready flew on countless high altitude flights above 30,000 until his record flight of 40,800' which was witnessed by Orville Wright, official of the International Federation Aeronautique. These flights led to the perfection of our current day turbosupercharger. The open cockpit plane was pushed to its ultimate limits by Macready, who suffered extreme physical hardship due to the -85°F temperatures, the lack of oxygen (taken directly into his mouth through a welder's flask) and the lack of pressure.

As Macready wrote in his National Geographic article of December, 1926, "It is lonely work fighting the elements at the earth's ceiling, but I hope that my six years spent in high altitude experimental work have produced something of value to our Government".

Just wanted to set the record straight on this important segment of our country's aviation development.

Sincerely,
David B. Dewey
AET '48
Rancho Santa Fe, CA

Wing Spans Globe

During a recent visit to the United States, I obtained a copy of your NUANCE Magazine April/May 1982, with a story on Mr. George Wing, a close personal friend of mine.

If it is possible for me to obtain one or a few copies of your magazine, it would be greatly appreciated. We are of course happy to pay any charges or postage for some copies of this magazine.

Thanking you in anticipation.

T.J. Watson
Director,
Aviation Industries
Bankstown, N.S.W.
Australia

I recently received a copy of your magazine and wanted to write you to tell you how much I enjoyed reading it. It was the April/May issue and I particularly enjoyed the article about George Wing.

Cal Hi Ed begins publication August 27 as a monthly magazine for administrators, faculty leaders and trustees at the private and public colleges, universities and institutes in California.

I would be very interested in running an article about NU. Our readers are people interested in management issues related to higher education. NU is one of many "speciality" institutions in California that have been doing an outstanding job of educating its students without statewide recognition in the higher education business.

And again, NUANCE is a fine magazine. I hope our's is as good.

Sincerely,
Ray Giles
Publisher,
California Higher Education
Sacramento, CA

Your April/May 1982 edition of the NUANCE Just arrived today.

The article on George Wing is especially interesting to me because Mr. Wing is a personal friend of Wallace Waterhouse, my employer.

I'd like to have the article framed. Would appreciate it very much if you could send me a couple of these magazines since the article is printed on the reverse side of the pages.

Sincerely,
Myra H. Ching

We have seen a copy of your April/May issue which includes an article entitled, GEORGE WING & THE DERRINGER.

We are interested in contacting the author of the above article. Could you send us his name and address?

Any assistance you can give us would be greatly appreciated. Thank you.

Janet Bell
Associate Editor
PLANE & PILOT MAGAZINE
Van Nuys, CA

Your April/May 1982 issue of NUANCE was indeed worthwhile. "George Wing & the Derringer" was outstanding. I wish to be included on your mailing list for future issues to continue to read more enjoyable readings' about John K. Northrop, Max Stanley especially. Your full cooperation will be highly appreciated.

E.D. Miller, Director P.R.
Perfect Way's Company
Jamaica, N.Y.

Kudos

In your NUANCE "Response" column in the recent April/May issue I noticed a brief kudo from Doug Lamont and Bobbie Trout - Carol Osborne. Both old friends. I add mine to theirs!

I would greatly appreciate a few issues of the above issue, for talks I am giving.

Best of regards,
John Alden Barclay
La Crescenta, CA

Note: Back issues of Nuance are available at $1.00 each. For a complete list, including contents, please write: Back-Issues/Nuance, Northrop University, Inglewood, CA 90306.

B-26 Flies Again

I have much enjoyed your stellar publication since my late friend, Dave Hatfield introduced me to it. I have especially enjoyed the Northrop Flying Wing articles. What a magnificant concept!

I am attempting to recontact pilots and crew of the Ninth Air Force Martin "Marauder" B-26 groups. Could you include a notice such as this:

MARAUDERS - seeking WWII members of Ninth Air Force 455 Bombardment Squadron, 323rd Bombardment Group, who flew England/France in Martin B-26 "Marauder" medium bomber. Active veterans organization in operation.

Contact: R.M. Wefel,
114 Fontana Drive,
Oxnard, CA 93022
(805) 488-1343.

Your help is much appreciated.
Robert M. Wefel

It's a lively magazine - that well combines art and science.

Thank you for sending me the copy. I loved the George Wing story and the interview with Judge Shafer.

Arrola Du Bridge
ARCS Foundation
(Achievement Reward for College Scientists)

Send all responses to: Editor, Nuance, Northrop University, Inglewood, CA 90306.

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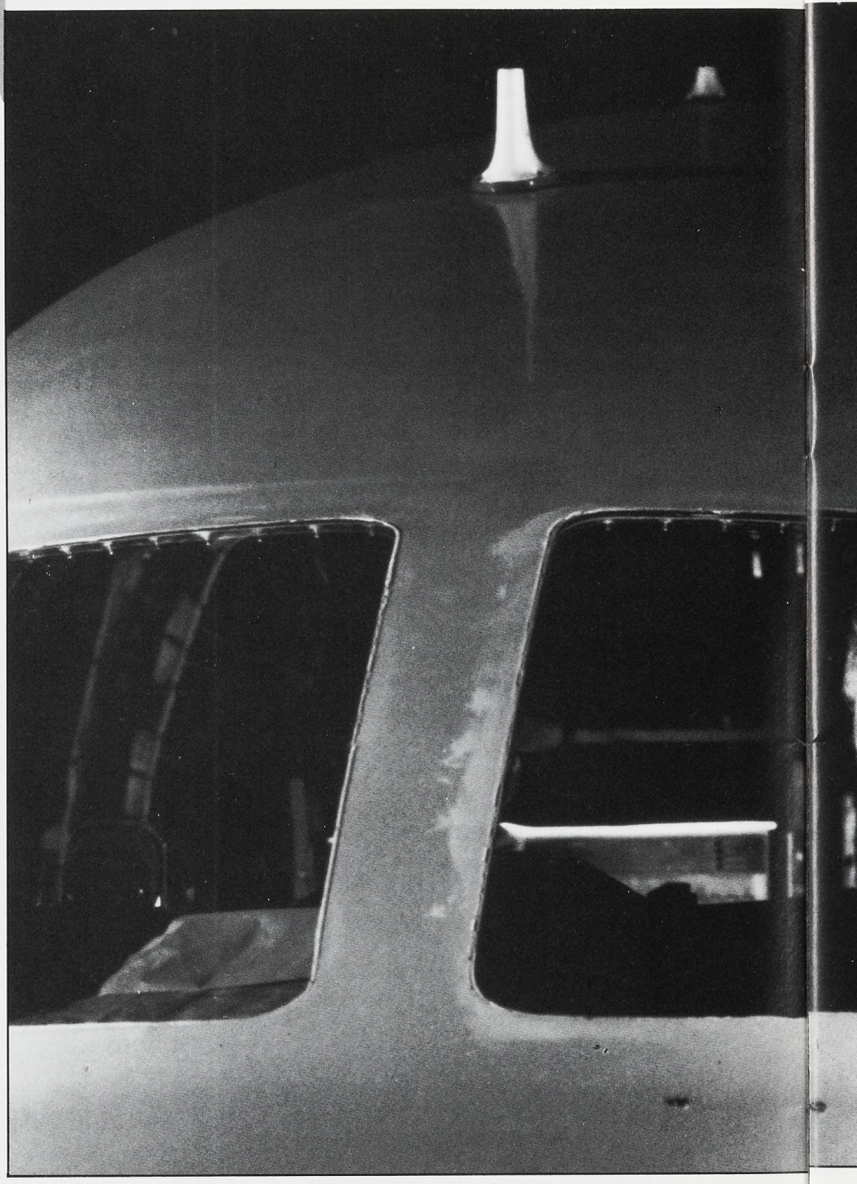
AVIATION INNOVATION

THE LADY AND THE LEAR FAN



It's, at best, a sporting place to be — out there at the leading edge of general aviation. But Bill Lear never was timid in his designs for the future. He patented the first car radio, the first compact auto-pilot, the eight-tract stereo, and 140 more inventions and designs. His Lear Jet was the first production aircraft in the world to be financed and produced by a single individual. Today, the Lear Fan is cutting a leading edge in general aviation as the first non-aluminum, all-graphite airplane.

Seven years ago, while speaking to a class of graduates at Northrop University, Bill Lear acknowledged two sources of his success: God and Moya Lear. Before he died of leukemia in 1978, he made sure the future of the Lear Fan project was in the hands of the diminutive lady, slightly five feet two inches tall, who had been his wife for thirty-six years. So, at 67, the mother of four children, and grandmother of eleven, Moya Lear is writing the last chapter of the book, WILLIAM P. LEAR VS. INERTIA. As Chairman of the Board of LearAvia Corporation, parent company of Lear Fan, she has seen the project through the design stage to the first flight test of the prototype in 1980, and now into rigorous flight and limit tests for certification.

With the air of a lady who likes to keep all bases covered, Moya Lear peered over the same podium at Northrop University where seven years before Bill Lear had received an honorary doctorate. "About the Lear Fan," she said, "Bill knew it would happen, but I'm going to make sure it happens."

They call her 'tenacious.' She knew at 23, on the night she met Bill Lear, that she was in love with him. It took her four years to convince him that his fourth marriage would work. Then, it took her thirty-six years as his wife to prove she was right. Today, four years and over one hundred million dollars worth of funding later, Moya Lear is proving a revolutionary Lear Fan to the aviation industry.

"After forty years with Bill Lear, I had to learn something, even by osmosis," she smiled. "I remember when he came out with the idea for a car radio and the president of Motorola told him Congress would legislate against it because it was

Moya Lear and the Lear Fan 2100.

photos: Paul Harris

distracting to the driver," she smiled. "Today, the patent for the car radio sits in volume one of WILLIAM P. LEAR VS. INERTIA."

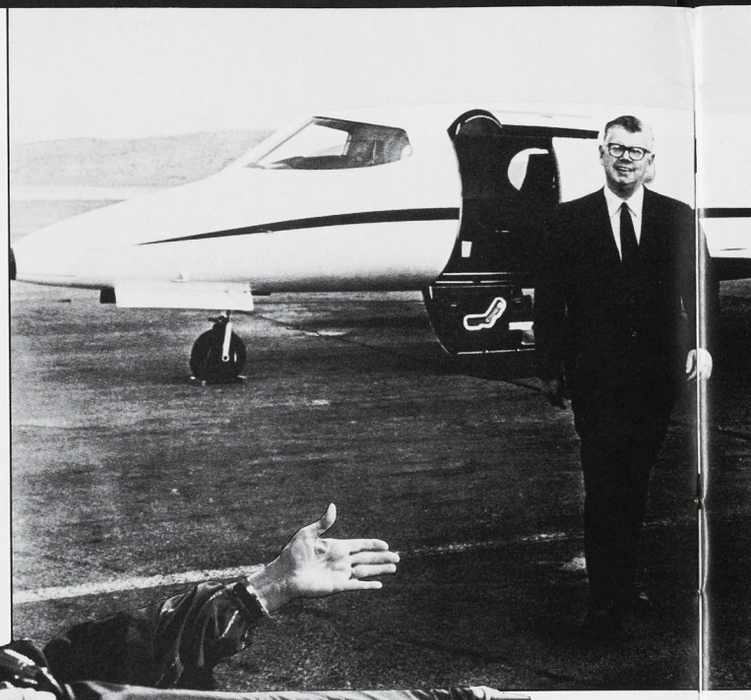
If tenacity helps build aircraft, personal conviction certainly helps market them. "There were those who said the Lear Fan couldn't fly," Mrs. Lear mused. "Then, there were those who said if it did fly, it couldn't land without coming apart. The real optimists said if it did fly and land, we couldn't sell it anyway. Well," she smiled, "it flew and it landed and we have sold 275 planes even before certification."

A very convincing chairman, Mrs. Lear has won a $50 million dollar investment from the United Kingdom for a Lear Fan assembly plant in Belfast, Ireland, which now employs over 500 people in the manufacturing of new tools needed for the Lear Fan parts. That funding was matched by private funding raised by Oppenheimer and Co. of New York, which sold limited partnerships at $150,000 each for a total of $30 million dollars in ten days. Word from Reno, Headquarters of the Lear Fan research and development project, says enough additional private funding has been secured this September for continued operations, through certification and production.

The leading lady at LearAvia has a way of sharing her opening night enthusiasm for the Lear Fan project. "It is the way aircraft will be built in the future, and we are cutting the leading edge every week, every day, every hour," she said. Her schedule says it another way. In one week, she flew down from Reno to Los Angeles for her granddaughter's graduation, then up to San Francisco to deliver a speech, and immediately on to Belfast, Ireland, for two days of board meetings before returning to Los Angeles to receive her honorary degree of Doctor of Laws at Northrop University.

As she says, "Conviction sells." Her most convincing statement is her style, the way she tells the Moya Lear story with a little bit of Broadway and a little bit of bankruptcy in the forty years with Bill Lear, his love for the ladies, and her many nights of needlepoint. Between securing investment funding and being a grandmother, she carried the show from Belfast to New York to Los Angeles and back to Reno before anyone noticed she did it alone.

AVIATION INNOVATION



AN OLSEN-LEAR PRODUCTION

as told by Moya Olsen Lear

Moya Lear tells the Olsen-Lear story at Graduation Exercises of Northrop University's School of Law in June.

There is no possible way I could have known that I would be Chairman of LearAvia, or that I could be. I would have been considered the least likely to succeed because I was a homemaker and I was Bill's geisha girl. I literally did a lot of needlepoint.

People ask me, "How do you do it? Where did you go to school? How did you learn all that?" It's difficult to explain. It was like all of a sudden a world series with everything piled up, bases loaded, and the count three to two, and I grab the bat and hit the ball out of the park.

My background helps to explain how complicated it is. I grew up on the road with my father traveling by train with our trunks. We'd arrive at some place like Southbend, Indiana at four o'clock in the morning and the company would stumble off the train and stand on the platform until the company manager would say, "You kids go to the hotel. You kids go there, and your trunk will be in the theater, and you . . . ." It was a whole different world of soul in the theater and it was the world I grew up in. When I was little, the first thing I learned was how to get from the hotel to the theater without getting run over.

My father criss-crossed this nation I don't know how many times, entertaining, and he loved it. He loved the whole human race and brought it all home with him to mother — that was one of his problems with mother.

My life on the road and in the theater with my father was just fun. In the 30's when the Depression hit, people were lined up in the rain with umbrellas to go to the theater and laugh. Everybody felt they could afford a laugh.

My dad was Ole Olsen, of the Olsen and Johnson musical comedy team. When 'Hellsapoppin,' opened at the Wintergarden in New York on Christmas Eve, I was my dad's secretary back stage. I got a message someone was outside at the front door waiting to speak to me. When I got there I saw it was Bill, someone my father had met the week before. So, I said, "What's a matter? Are you lost?" And he said, "No. I just thought you'd come and have a drink with me."

Well, I was 23 and never had a drink in my life. But I told the stage manager I'd be back in half an hour and Bill took me over to the Stork Club.

Then, he told me his third wife had just served him with divorce papers that day, on Christmas Eve. I thought that was the cruelest thing I had ever heard and so I listened with a lot of sympathy. That evening, on the way back in the taxi, I knew I was in love. We were married for thirty-six years and I was in love for forty. Bill used to say he was in love for about twenty.

But he was a very special human being, an original. After we were married in 1942, right after Pearl Harbor, we moved to a tiny little house in Dayton, Ohio. Bill taught me a lot in those three rooms. He taught me how to cook and how to fix my sewing machine and then when the war was over and they handed everybody a paycheck and told them to go home, Bill came back and taught me another lesson. I was afraid of losing everything and he came home and said, "Mom, don't ever worry. They can't bankrupt my mind." It was such a marvelous thing to say. He really believed that the mind is an infinite resource. It was a wonderful belief and it saw him through a lot of heartache.

Then, the 1950's came, and pilots approached Bill to design a compact auto-pilot because the only one in existence at that time was about the size of this podium. Now, Bill had an enormous talent for uncluttered reasoning. He could simplify design by asking right away, "What's that in

Bill Lear and the Lear Jet are in the background

there for?" We wound up with an automatic pilot for general aviation about the size of two cigar boxes. It brought him the highest award you can win in this country for a contribution to general aviation.

Then came the decade of the 60's and Lear Jet. Bill had Lear Incorporated and the Board of Directors told him, "Bill, you don't know a thing about building an airplane or marketing it." So, they voted against him. Bill said, "O.K." and sold the company to Siegler, and that's how you get Lear Siegler. Bill sold out to build his small jet airplane. He started Lear Jet by floating a bond issue in Wichita to get the money to build the hangar. When the team of engineers got behind him, he was over in a corner designing his plane.

At one time, I gave him two bound volumes of his 150 patents and titled them WILLIAM P. LEAR VS. INERTIA. In the first volume was the automobile radio. He also has in there the first Automatic Direction Finder for pilots. Bill was someone who showed direction.

When the 1970's came, he was convinced we needed a clean engine for automobiles. At that time, pollution was a big concern. But by the time we built the steam turbine engine, the emphasis was all on fuel economy. And there is no way you can get a steam turbine engine to burn efficiently. So, we had $17 million dollars invested in the development of the steam turbine in automobiles, only to prove it doesn't work efficiently. Well, at least no one else needs to try.

There aren't very many people who can take a $17 million dollar loss, pick themselves up by the collar, dust themselves off and say, "All right, we'll build an airplane." But Bill did.

Right before the 1980's, during the last two months of Bill's illness when we were designing the Lear Fan, he kept saying, "Mom, don't let anything happen to this project."

And the day he died, I went to his office and sat at his desk. I had enough pills stored away to kill an elephant because I thought I wouldn't be able to live without Bill. But sitting at his desk I felt so close to him, surrounded by his plans and designs. I got caught up in the project.

Bill left six million dollars. You could put that in your ear when it comes to building a new aircraft. But it was seed money and it kept us going until we got the British government to invest $50 million dollars. Now, the $50 million is gone and we are into the second phase of production when you have to make new tools.

But that first flight of Lear Fan was the most exciting first in aviation history. We had a contractual agreement with the British government to fly the plane before January 1, 1981. Well, December 30 came and we couldn't do it. December 31, we got it going. Both engines started. Everything fine. We made a high speed taxi down the runway and came to a screeching halt. The brakes got hot and blew the tires out. Everything came down.

But like the Indianapolis Speedway racing teams, our team changed the brakes, changed the tires, got it ready to go again, and I said, "Just take off and land, man, that's all you have to do."

They got into the cockpit and accidently flipped the switch that filled the cabin with foam and that was the end of the 31st. So, they worked all night and the next day they flew the airplane. The British were the ones who designated it December 32, 1980 so that we could meet the contractual deadline officially.

Right now, walking into the plant in Reno, you will see number 003, our second airplane ready to fly, and parts of two other airplanes that are beginning to go together. In Belfast, you will see a lot of beautiful tools for building new aircraft. Somewhere around September of 1983, we will get our certificates and start delivering aircraft. We plan to deliver six or eight next year.

That will be the final chapter in Bill Lear's career.

From a test pilot's point of view:

THE LEAR FAN CHALLENGE

by: George Harrison

Conceived in the shadow of the oil embargo and escalating fuel costs, the Lear Fan Model 2100 is the late Bill Lear's uncompromising commitment to the most fuel efficient corporate airplane design possible. To achieve this goal, the Lear Fan departs radically from conventional aircraft manufacturing in both design and structural material.

Radical Changes

The Lear Fan 2100 will be the world's first all-graphite aircraft. It has been called the first plastic airplane, and the world's first non-aluminum aircraft. Bill Lear, famous for his "take the big bite" attitude, made the revolutionary decision to manufacture an airplane from the composite material graphite-epoxy, which is half the weight of aluminum and twice as strong.

Nearly all the primary structure (fuselage, wing and empennage) is composed of graphite-epoxy lay ups, while most of the secondary structure (flight controls, fairings, etc.) and the pusher propeller are constructed of Kevlar.[1] Garden-variety metals, such as aluminum and steel, are only used as a last resort for such components as the landing gear, engines, fasteners, and electrical and avionics equipment, or as necessary to provide a path to dissipate potential lightning strike currents.

A Carbonfibre Aircraft

The new composite material, graphite-epoxy, begins as a rayon which is run on a hot mandrel to make carbonfibre threads. The Lear Fan makes extensive use of graphite-epoxy cloths which have been woven from the carbonfibre threads and empregnated with epoxy resin.

At temperatures ranging from 250 degrees to 350 degrees Fahrenheit,

the epoxy resin goes into solution and ultimately hardens into a matrix encasing the carbon filaments. This process is used to produce the fuselage and wing skins, spars, frames, longerons, bulkheads and brackets which are assembled together in fixtures using fasteners or bonding agents. The resulting assemblies are roughly twice as strong and only half the weight of comparable aluminum structures, and will not fatigue or corrode — a structural engineer's dream come true.

The pre-cured, pliable graphite-epoxy cloth permits the use of compound curves, while bonding reduces excrescence drag caused by fastener, lap, and seam protuberances. The rigidity of the post-cure lay ups prohibits "oil-canning." Thus, complex aerodynamic shapes conducive to low drag, laminar airflow are quite practical — an aerodynamicist's dream come true.

In terms of fuel-efficiency performance, these changes in structural material permit the Lear Fan, which is the fastest turboprop in its class, to use one-half the fuel of any competitive turboprop.

Radical Propulsion System

The Lear Fan propulsion system presents another radical departure from the norm in turboprop technology. The two turboshaft engines are buried in the aft-fuselage and drive independent six-foot long graphite-epoxy drive shafts coupled to a single transmission, via flexible couplings and sprag clutches. The transmission, mounted at the tail of the airplane, powers a single, four-bladed scimitar, Kevlar pusher-propeller.

The decision to place the engines inside the aft fuselage reduces frontal area and the attendant drag. Because engines are complex, contain many moving parts, and have numerous failure modes, two are provided. Because the propeller, on the other hand, is a relatively simple device with few moving parts, and boasts an excellent safety record,[2] only one is provided, thus minimizing weight, cost and complexity and permitting the all-important use of centerline thrust.

An engine failure in the Lear Fan does not result in the dangerous asymmetric thrust and engine-out drag associated with most conventional twin-engine corporate airplanes. There is no immediate requirement to feather a propeller, since the sprag clutch automatically disengages the failed engine.

With 650 horsepower per side, the Lear Fan's single engine climb performance exceeds the twin engine climb performance of many competing airplanes. Centerline thrust also permits the use of a smaller vertical stabilizer and rudder, which reduce surface area and its associated parasite drag.

Because the engines and propeller are mounted well aft, passenger cabin noise and vibration levels are low. The scimitar-shaped propeller blades generate less noise also, helping to make the Lear Fan a good neighbor in the airport vicinity. Finally, because the propeller is aft of the airplane's center of gravity, it enhances stability, thus improving handling qualities and passenger ride comfort.

Unique Configuration

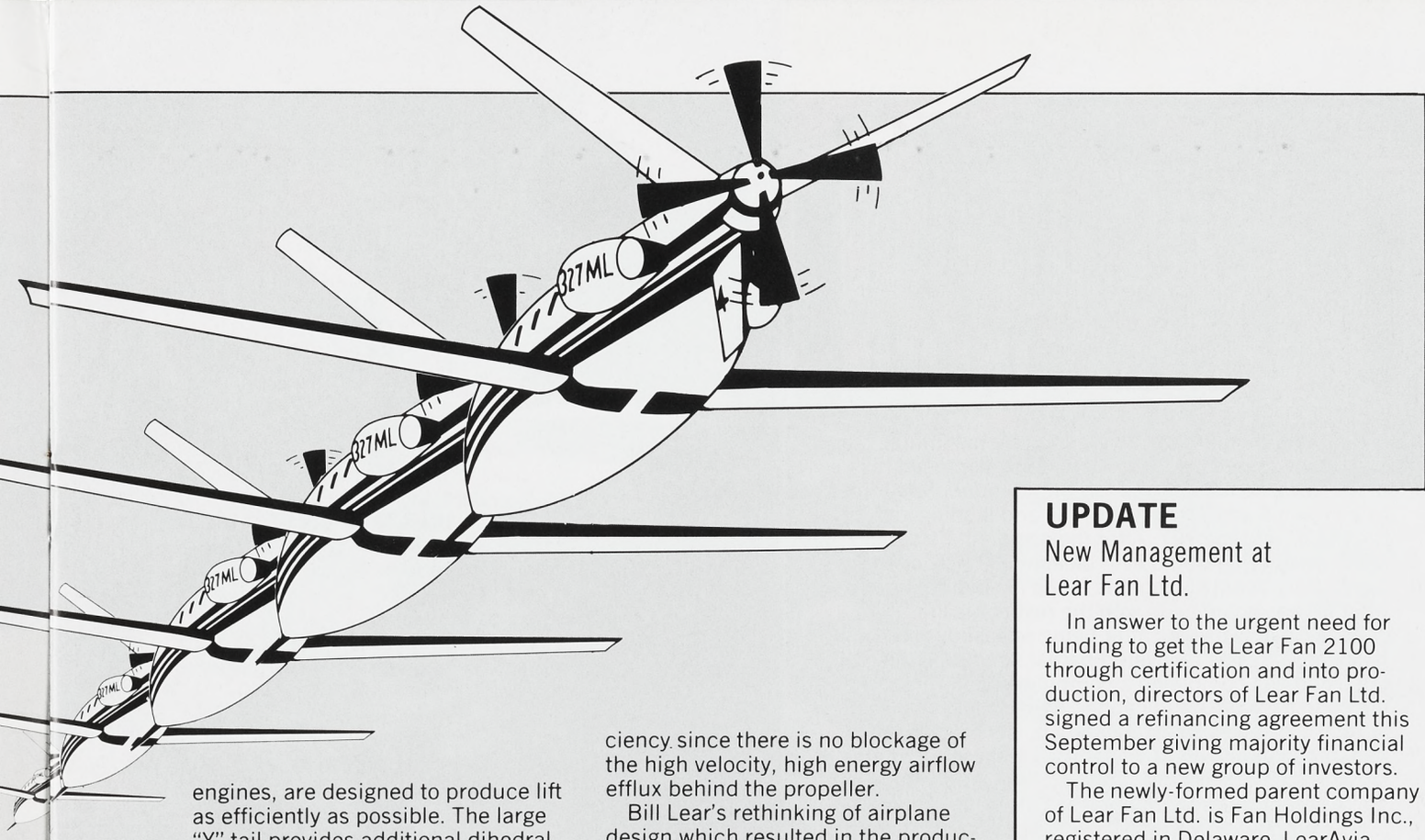
Last, but not least, the unique configuration of the aircraft gives it unusual efficiency, stability and handling qualities. The wing's airfoil section was designed by Lear Fan engineers using advanced computer methods and airfoil technology allowing laminar airflow over previously unattainable percentages of the wing and fuselage surfaces.

The clean wings, uncluttered with

On the eve of certification, flight-test engineer George Harrison explains the Lear Fan challenge to general aviation.

Biographical Sketch

George Harrison started flying at age 15 in Cincinnati, Ohio. He graduated from Northrop Institute of Technology in 1967 with a Bachelor of Science in Aeronautical and Aerospace Engineering. He was employed as an aerodynamicist on the Cessna Citation Project from 1968 to 1970. During his service in the USAF from 1970 to 1976, he flew the T-37, T-38, C-141, and C-5 aircraft. He has also been a Flight Test Engineer for Aerostar and Boeing Commercial Airplane Company before joining Lear Fan as a Senior Flight Test Engineer and Test Pilot.



engines, are designed to produce lift as efficiently as possible. The large "Y" tail provides additional dihedral for lateral and directional control and stability. And, the rudder is where it should be on an airplane, — below the center of gravity. Applying rudder in a Lear Fan does not produce the adverse roll a pilot might expect in other aircraft which gives it an unprecendented control harmony. The ventral, vertical stabilizer is designed to absorb ground impact loads and protect the propeller should the airplane be over-rotated on take-off or during the landing flare. Finally, the placement of the propeller at the rear of the engines, allows a high level of operating efficiency since there is no blockage of the high velocity, high energy airflow efflux behind the propeller.

Bill Lear's rethinking of airplane design which resulted in the production of the Lear Fan, captures the engineer's imagination and challenges conventional aircraft manufacturing with innovations which may well set an industry standard for the 21st century. nu

[1]Kevlar is an Aramid (chemical) fiber used to produce materials similar to those of graphite-epoxy in form, composition, and mechanical properties.

[2]The failure rate of fatigable aluminum propellers driven by turbine engines is less than one failure per one million flight hours. The Lear Fan's Kevlar propeller will not fatigue.

UPDATE

New Management at Lear Fan Ltd.

In answer to the urgent need for funding to get the Lear Fan 2100 through certification and into production, directors of Lear Fan Ltd. signed a refinancing agreement this September giving majority financial control to a new group of investors.

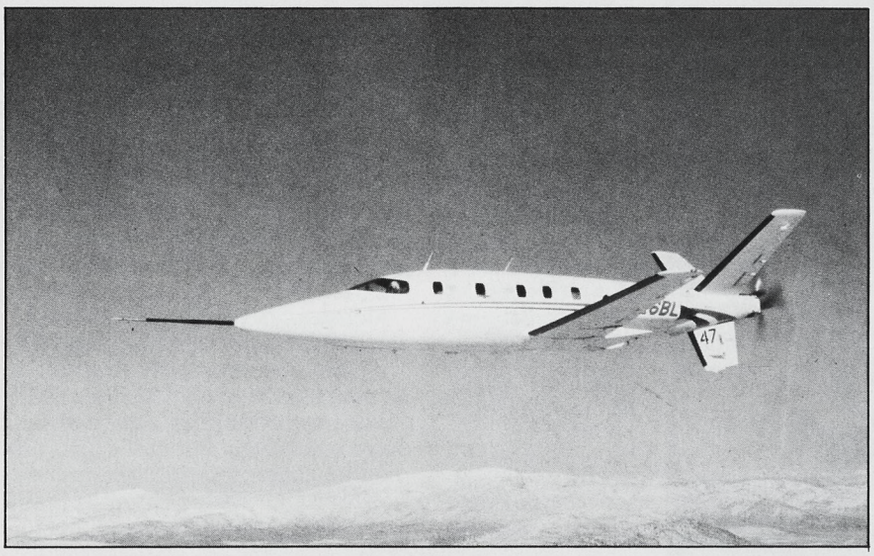
The newly-formed parent company of Lear Fan Ltd. is Fan Holdings Inc., registered in Delaware. LearAvia Corp. held by the Lear family and others close to the late William P. Lear will continue to hold an equity in Lear Fan, but it will be a minority equity, according to Walter Bonner, Director of Sales at Lear Fan, Reno.

The new chairman and chief executive officer of Lear Fan Ltd. is Denver oilman Bob Burch. The newly appointed vice president is R. Allen Price, an aeronautical engineering consultant based in Denver.

"The change in top management," Bonner said, "represents a vigorous commitment to the technical side of the operation. We will be concentrating on getting the Lear Fan certified and into production on a very realistic schedule," he said.

"Moya Lear will remain on the Board of Directors," he added, "and will always be considered the 'den mother' at Lear Fan."

Other investors in the project include Saudi Arabian capital, Northern Ireland's Department of Economic Development, and Oppenheimer Partnerships of New York.



The Lear Fan in flight: The eight-passenger turbo prop cruises at 41,000 feet high and 400 mph.

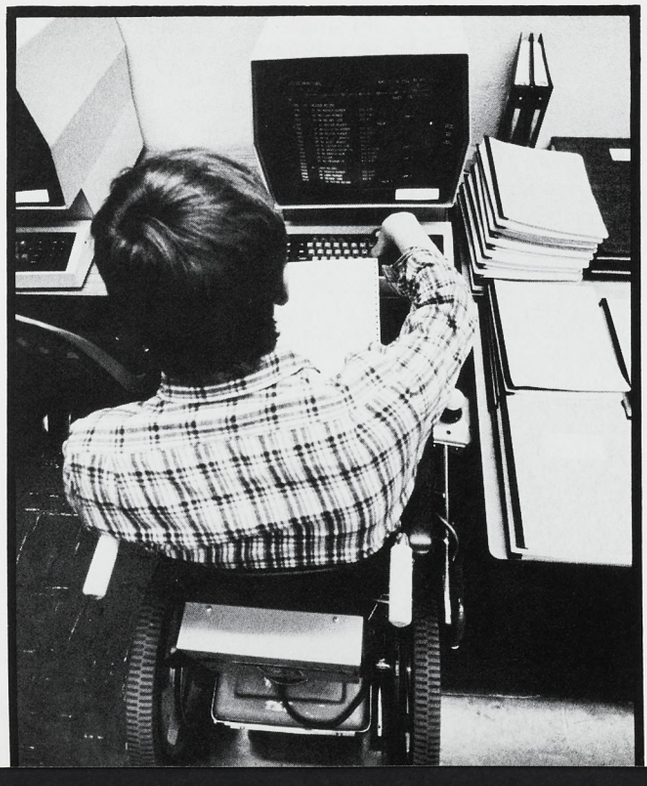
DOORS TO INDEPENDENCE

Gary Oka thought he had planned for his future. Before the dune buggy accident which damaged his brain stem, he held a good job with Continental Airlines as a systems analyst for the brake and landing gear of the DC-10 and the 727. After the accident, he didn't know whether he would ever be able to move, or speak again. Gary spent six months in the hospital wondering what he was going to do with the rest of his life.

Today, just two years after being released from the hospital, Gary has recovered partial strength in his upper torso and has completed a computer programmer training course for the handicapped. When the alarm goes off at 5:15 a.m. every weekday, Gary hoists himself out of bed into his wheelchair and starts his morning routine of shower, shave, breakfast, and catching a ride to his new job in computer programming at TRW by 8:30 a.m.

"I've timed it about right," Gary explaines. "The routine is automatic. The biggest problem I have is learning which way doors open and how to get through them fast. This is pretty tricky if you are in a wheelchair and have only partial strength in your arms."

Learning which way doors open could be the name of the challenge facing each of the 26 handicapped students who want to get back in the door to work. The door to independence opened for many of them with the pilot program of Westside Community for Independent Living's Computer Programmer Training Project held at Northrop University. All of the handicapped students shared a driving motivation to get back into the work force and support themselves.



(Above) Determined computer students sometimes make use of an arm brace to type on the keyboard. (Left) Wheelchairs are no handicap at a computer terminal. Before graduation, students spend hours designing their own program to handle specific business problems.

A NEW KIND OF E

by Ruth Stroud

"The inability to join the nation's work force is one of the most serious problems facing persons with severe disabilities," said Dave Trogan, Senior Vice President of Security Pacific Bank and Chairman of the Business Advisory Council for Independent Living's Computer Programs.

Members of the first graduating class of the Computer Programmer Training Project will probably not face an employment problem. The lucky 26 who received their certificates in June were part of a 12-month pilot program taught on the Northrop University campus. Since June 1981, a select group of 26 stu-

OF EDUCATION FOR THE HANDICAPPED

dents with severe disabilities spent an average of six classroom hours a day working on state-of-the-art IBM computer hardware under the watchful eye of some of the top southern California business leaders toward the eventual goal of becoming entry-level computer programmers.

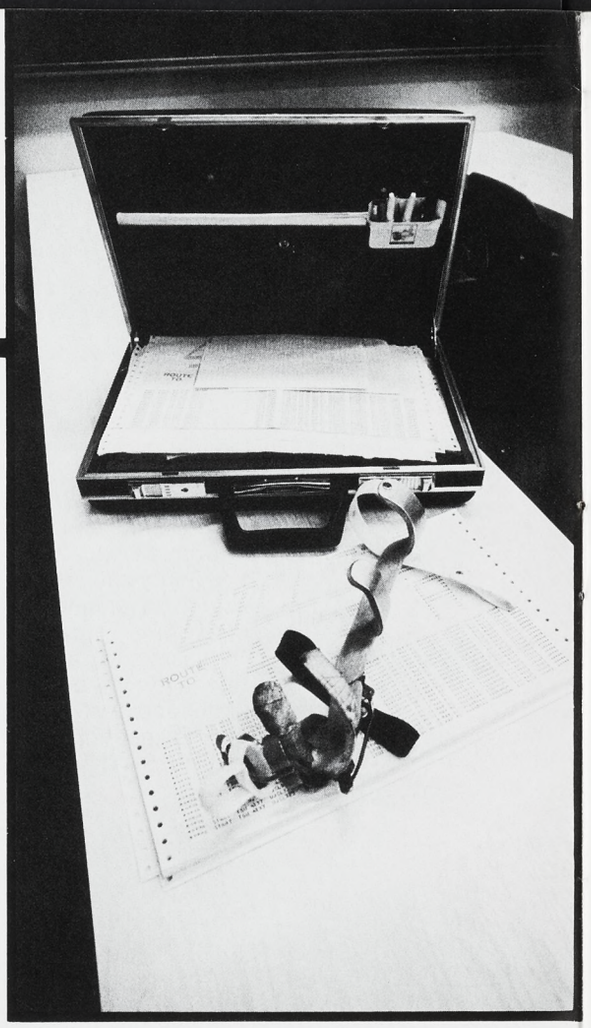
As of this August, Ten students have already been placed in jobs with salaries ranging from $17,000 to $23,000. "A high paying career is a necessity for most severly disabled who want to lead independent lives," said Jack Grubbs, the incoming project director of the WCIL computer training program at Northrop University. "The high cost of medical care and equipment for the disabled makes independence very expensive."

Wheelchairs, for instance, come with a big price tag. A manual wheelchair will cost about $1,000. A battery-powered electric wheelchair will cost between $3,000 and $4,000. These are the initial costs and do not include maintenance and replacement of wheels, upholstery, frame or batteries. A ramp for the home which allows the wheelchair to bypass steps, may cost $300 or more.

The most feasible mode of transportation for some quadriplegics is a specially adapted van. Such a vehicle can be modified to include hydraulic lifts and hand controls for driving. The hydraulic lift alone costs $3,500 to install. A completely adapted van will cost approximately $14,000.

The Department of Rehabilitation, Medicare, Medical and Supplemental Security Income will generally pay part or all of these costs. **However, the benefits of most of these programs end when a person becomes employed. This makes it necessary for a disabled person to pursue a career, such as computer programming, which will pay an adequate salary and provide medical benefits.** (continued)

> "Many in the business community have recognized that those with disabilities make better employees. They're super-dedicated. Their absenteeism is less . . . they're going to make good employees."



What appears to be a minor miracle has been accomplished as a joint effort between WCIL and key business leaders representing some of the southland's major corporations. The latter formed a Business Advisory Council (BAC) to oversee, curriculum, progress and placement of these students. The program, funded for the first year by the California Department of Rehabilitation, is expected to receive the major portion of its subsequent funding from the private sector in the form of placement fees and contribution from business and industry. In a recessive economy where public monies are rapidly drying up, "We would rather have a program as self-supporting and independent of government funds as possible," says WCIL executive director June Kailes.

Some History

IBM has been credited with the original ideal of training people with disabilities to work as computer programmers and has been instrumental in setting up several programs similar to the WCIL sponsored effort around the country. **But until the Northrop University-based Computer Programmer Training Project, none existed in Los Angeles County, which is one of the areas of largest demand for computer programmers.**

So, in late 1980, an IBM representative helped bring delegates from the Department of Rehabilitation together with members of the business community for a breakfast meeting to kick the idea around. Shortly thereafter, a $32,000 seed grant from the now defunct CETA (Comprehensive Educational Training Act) was used to hire Bob Taylor, a 25 year veteran of the brokerage firm, Bache. As the project director for the nascent computer programmer project, Bob recalled, "It was up to me to hire a staff, put together the Business Advisory Council and find a location for the program."

Northrop University agreed to house the classes and provide space in the dormitories for four quadriplegics on a contractural basis. The school remodeled a suite for the students, as well as a classroom/office area.

It was also up to Bob to convince the financially-strapped Department of Rehabilitation to grant a substantial amount of money - an estimated $8,000 per student - for the first year's program. But with the backing of a committed group from corporations like Security Pacific National Bank, Northrop Corporation, Southern California Edison, ARCO, Southern California Gas, IBM and Ralph's groceries, the Department of Rehabilitation was won over.

Top Notch Group

Meanwhile, students selected by the Department of Rehabilitation were required to pass both written tests of aptitude, skills and IQ, as well as interviews with counselors before being admitted into the program. Tests measured motivation as well as ability. Along the way, six out of the original 32 students selected dropped for medical, academic or personal reasons. The rest elected to complete a rigorous courseload patterned after a training program used at Security Pacific National Bank. Included in the curriculum were: introductory BASIC, modular programming concepts, structured COBOL, flow charting, program design and employment preparation. Also required were three programs of increasing difficulty requiring 14 weeks of independent work. Equipment included eight IBM 3277 remote terminals feeding into an IBM 3081 mainframe computer located at Northrop corporation. Curriculum, hardware and student progress was supervised by the Business Advisory Council.

Bob Taylor noted that the rigid requirements for admission took care of any potential physical problems. Students are only accepted who have a certain amount of manual dexterity. In certain cases of quadriplegia which causes limited arm movement, the person may wear an arm brace and use their shoulder muscles to move a pencil attached through a slot. But the theory behind the program has been that these are students with certain disabilities who are mentally prepared for this job, says Susanne Davis, Department of Rehabilitation District Administrator. (L.A. Coastal District) "Many in the business community have recognized that those with disabilities make better employees. They're super-dedicated. Their absenteeism is less. There have been studies that show they're even higher in productivity (than other workers) because of their attitude. And they're going to make good employees."

The Students

One of these, Dennis Berg, was valedictorian at the commencement June 25. A handsome 26-year old from San Diego, Dennis was left a quadriplegic following a diving accident at 17. He had some previous work experience as an accountant, but said he couldn't function fast enough to be efficient. In this program, he says he has limited use of his hands, employing one finger to work the keys of his terminal. Occasionally, he uses a pencil attached to a brace.

"But I'm not limited in my programming ability," he firmly asserts. "I've seen others in the class who have the whole use of their hand and they've been slower." He likes the idea of working for a big corporation and notes that he finds computer work challenging, "There's so much to learn. This is just the tip of the iceberg,." he said.

A dark-haired, attractive woman of 30, Mona Lisa Henderson is extremely enthusiastic about the program, especially the idea of supporting herself and a 14-year old son. Mona, who speaks with a slight lisp, suffers from a back injury caused from a fall on rainslick pavement. Before that, she had worked for a bank for almost 10 years and had advanced into a management position at the time of her accident. Continuing back problems kept her from returning to her old job. She has been surviving on Workman's Compensation and has had to move back into her mother's house to make ends meet.

Mona expects to make about $18,000 when she finishes and gets a job, but, an ambitious lady, she dosen't look on a programming position as her ultimate goal. "I see this as being the spring-board to management," she says confidently. "The thing about this program is that we're about to start new in something that isn't mediocre. Every magazine you pick up, computers are in there and, no matter how automated the world gets, someone always will have to run them."

Mona says she is "honored" to be in the program, the pilot for many more to come, she hopes. Before coming here, she was in a catch-22 situation, she recalls, never knowing whether to tell a prospective employer about her disability.

What Happens Next

Those who do the hiring — the big corporations — are tightening their belts somewhat, according to Dave Trogan. Although the demand for programmers is still high, the current recession is causing big companies to scrutinize their dollars a bit more closely and opt for experienced programmers rather than trainees.

The new batch of about 20 students which started this August will be largely funded by either placement fees or corporate contributions. The recruiting fees and contributions will be supplemented by $2,900 tuition per student provided by the Department of Rehabilitation. Though the goal is to be as self-sufficient as possible, WCIL executive director June Kailes says, "I think the Department of Rehabilitation will always play a role." To Kailes, the program is still a unique example of a successful application of the prevailing Reagan philosophy of partnership between private and public sectors. "I think we've made a real good start," she says.

Of the ten placed so far, seven are in programmer trainee positions, while the other three are working in data processing. Host companies include: Ralph's Groceries, Northrop Corporation, Security Pacific National Bank, and Southern California Edison, Southern California Gas and TRW. All members are of the Business Advisory Council.

As far as convincing business that people with disabilities are able to do the work, Susanne Davis, Department of Rehabilitation Administrator, notes that their clients are taught to talk about what they can do, not what they can't in an interview with a prospective employer. "There's not one of us who couldn't call something they aren't good at a disability," she explains. nu

WCIL The Westside Community for Independent Living is a private non-profit organization based in West Los Angeles that provides counseling, employment assistance and other services to people with disabilities. WCIL is managing the Computer Programmer Training Program in cooperation with the Business Advisory Council. The organization was founded in 1976 in order to provide people with severe disabilities the tools to independence.

Ruth Stroud is a free-lance writer living in Mailbu, California.

Jay Wyman, 26, has good reason to smile. He just entered the Computer Programmer Training Project when he learned the State of California would cover the expenses.

"... a minor miracle has been accomplished ..."

update

Stars and Stripes Celebrate the 40th

Space, Ballistic Missiles and a University Commemorate Beginnings

"The rockets' red glare" doesn't always mean "bombs bursting." In this case, it was the ballistic missile beginning of the U.S. Space Program. It was also the historic beginning of the West Campus of Northrop University.

On June 26, Northrop University celebrated the historic significance of the buildings on West Campus which served as headquarters of the U.S. Air Force Intercontinental Ballistic Missile and Space Program from 1955 to 1962.

Under the direction of General Bernard A. Schriever, (U.S.A.F. retired), the ICBM program in Inglewood, developed the Atlas, Titan I, Titan II, Minuteman ICBM,' and the Thor IRBM. Pioneering space and defense projects began in the same rooms where students today study law, engineering, and business in Northrop University's West Campus.

Representatives from the major aerospace and defense contracts corporations attended the commemoration ceremony. General Schriever arrived from Washington D.C to receive an honorary Doctor of Science degree at Northrop University's 40th Anniversary Graduation Exercises, and to unveil the bronze commemorative plaque on West Campus.

General Schriever

Dr. Ivan Getting, Founding President of the Aerospace Corporation, reminded the audience of university, industry and Air Force members that the public announcement of Aerospace Corporation was made in the Ballistic Missile Division headquarters in Inglewood on June 25, 1960, almost twenty-two years ago to the day.

Northrop University acquired the buildings from the Air Force for educational purpose in 1975. From what is now the Northrop University West Campus came Atlas and Titan in their several versions, the Thor IRBM and the initial work on Minuteman, all of which in addition to their ballistic missile intent, also became the basis for both the civilian and military space programs of the subsequent three decades.

Aviation Law

Symposium Explores Future of Airlines

Celebrating its tenth anniversary, the School of Law at Northrop University presented Aviation Law Symposium '82 on September 24, at the Sheraton Plaza la Reina in Los Angeles.

The symposium began with a discussion of the "International Framework of Air Transportation," including the rights and restrictions of the international system, by former Chairman and President of Eastern Airlines, Floyd D. Hall.

Expert litigators on mass air disaster form part of Law Symposium Tort panel. (left to right) Ned Good, Gerald Stearns, Thomas Sharkey

Difficulties of financing international carriers was discussed by Charles Tillinghast, Jr., former President of Trans World Airways and currently Vice-President of Merrill Lynch, Pierce, Fenner and Smith. Special guest speaker, Knut Hagrup, Chairman of the Air Transport Committee of the International Chamber of Commerce, presented a global evaluation of the airline industry from a multi-national point of view.

A full transcript of the symposium will be published in The Northrop University Law Journal of Aerospace, Energy and the Environment.

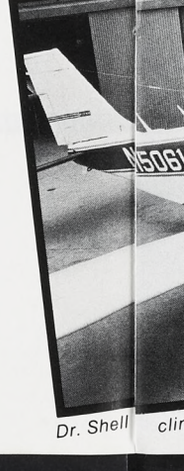
Academic Co-op Program

The Twain Meet in Tech-Liberal Arts

By integrating specialized curricula of technology and the social sciences, Northrop University and Azusa Pacific University created a joint program for students who wish to combine engineering and technical training with religious and liberal arts studies.

Under the new program, leading to a Bachelor of Science degree in Aerospace, Electronic or Mechanical Engineering, students enroll for the first two years in the Christian, liberal arts courses on the Azusa campus and receive engineering instruction from visiting Northrop University professors. The last two years are completed in full-time study at Northrop University.

Dr. Paul Sego, President of Azusa Pacific University described the program as a necessary extension of his University's purpose. "One of the main goals is to graduate a person who can be of service to society. This kind of technical-liberal arts program gives students a better opportunity to participate in a mechanical and scientific age."



Dr. Shell

update

Education's Hardware

Hi-Tech Donations

Over the last academic year, Northrop University received a variety of equipment from a growing base of support among friends and industry.

- John Kirk, Sr., President of Universal Heritage Investments Corp. donated a twin engine Piper Seneca aircraft for the avionics, airframe and powerplant programs.
- Bill Moore, District Sales Manager for Hewlett Packard, personally delivered $20,000 of new electronic test equipment to the Electronic Engineering Department.
- McDonnell Douglas, Northrop Corporation, and Cincinnati Millicron each donated numerical control equipment.
- Fowler Aeronautical Services donated training equipment and mockups for the 707 and 720 Flight Engineer's program.
- Charles F. Gress donated a complete and operational Link Pilot Trainer with spare parts.
- Alamo-Rent-a-Car presented a 1977 Dodge bus which is currently in use as a student shuttle between campus locations.
- Pacific Scientific Co. gave a National Semiconducter PACE Program Development System and computer equipment.
- Pioneer Tool and Equipment Co. gave a drill press and tools.
- The U.S. Air Force at Edwards presented an analog computer on loan.
- Flying Tigers gave a valuable set of overhaul manuals.
- Fluor Corporation, through Tom Goff and Gary Wallace, gave a set of Collins Manuals of HF Equipment.
- TWA presented the Avionics Department with a passenger entertainment system.
- David Jones gave the Helicopter Program a Benson Autogyro.
- Shell Film Co. of Shell Oil in Florida gave eight major training films to the Institute of Technology.
- Hal Newmark of San Pedro gave the Institute of Technology a King Radio, and Roger Fick of Chadwich-Helmuth Co. gave electronic test equipment for helicopters.

Shell climbs aboard the Piper Seneca, donated by John Kirk

Those Daring Young Women and their Flying Machines

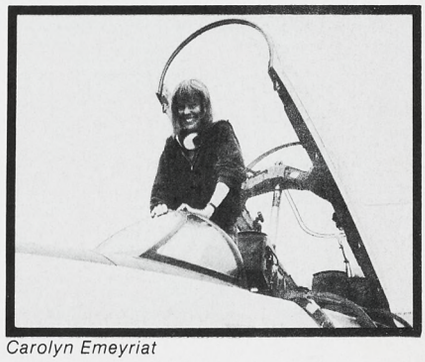
More and more women are entering different facets of the aviation industry, from maintenance to engineering, flying and education.

Sylvia Rickett, at 24 years old, is the new president of the Los Angeles Chapter of the Ninety-Nines, an international organization of licensed women pilots founded by Amelia Earhart. She is also the first woman instructor at Northrop University's Institute of Technology where she assists in courses on basic science, electricity, avionics, flight instruments, and helicopter maintenance.

For her progress as a racing pilot, Sylvia Rickett was also voted the Ninety-Nines' Pilot of the Year.

Carolyn Emeyriat entered aviation through a different route. As an English teacher at the Ecole d'Aerotechnique in Quebec, Canada, she is concerned with Special Purpose English for Aviation Technicians. In order to teach the technical vocabulary properly, Carolyn applied for a faculty development grant from the Ecole in Quebec, to enter the Airframe and Powerplant program at Northrop University's Institute of Technology. At the end of the 52 week program, she graduated as the top scholar in her class, receiving the Scholastic Achievement Award.

No English teacher ever clutched a box of mechanics' tools as proudly as Carolyn Emeyriat when she returned home to Quebec as a certified aviation technician.



Carolyn Emeyriat

Speaking of Brains . . .

Computer Graphics Program Wins $37,500 NSF Grant

A new program using computer graphics to enhance students' ability to visualize concepts in three dimensional images won the Computer Science Department a $37,500 grant from the National Science Foundation, as well as $17,000 of computer equipment from Atari.

Dr. Murray Teitell, Chairman of the Computer Science Department, designed the program as a tutorial project in three dimensional visualization using computer graphics. According to Dr. Teitell, engineering students are taught to think exclusively in words and symbols. Drafting courses have only been partially successful in teaching students to reason in three dimensions. Now computer graphics provides a new tool for students to graphically visualize math and science concepts. The immediate goal of the program is to better prepare students for computer-aided design.

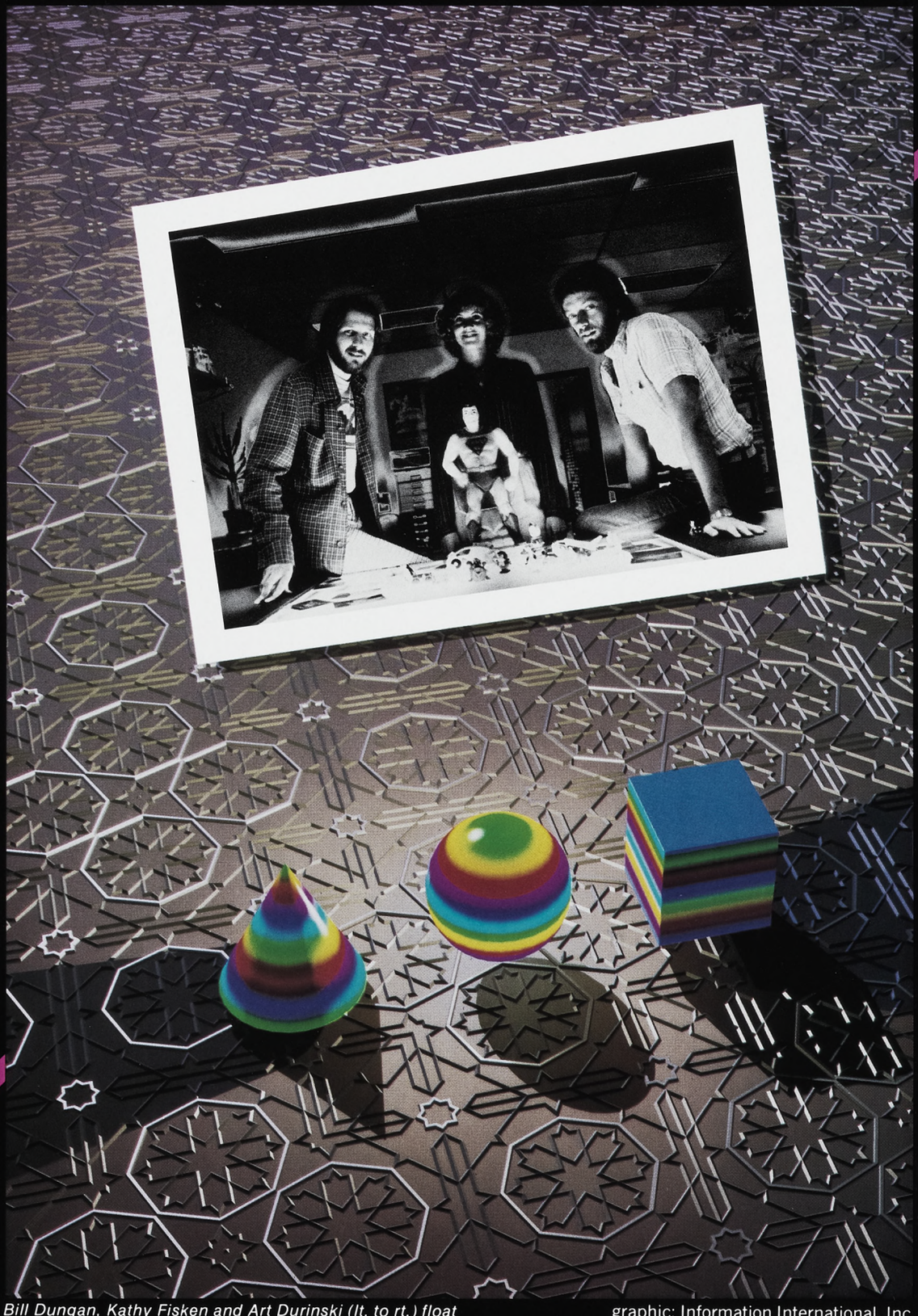
SUPERCOMPUTERS ANIMATE THE SCENE

Einstein would have loved the way Foonley creates a universe. Foonley, being a one-of-a-kind supercomputer, can create multi-dimensional moving images in a universe of rapidly shifting perspectives, all within a two-dimensional strip of film. And, Foonley is only four years old.

Built in 1978 by Jack Holloway and Dave Poole out of MIT and Stanford, Foonley is a mathematical colossus. Working with digits, Foonley records a numerical value for each discrete piece of information encoded on an electronic drawing tablet. Out of this brave new world of math and electrons comes what is called digital scene simulation, or computer animation. TRON, the Walt Disney movie, is the first feature-length film to make extensive use of computer-generated animation, and Foonley, the supercomputer at Information International, Inc. in Culver City, California, was actively involved.

Building, blowing-up, and rebuilding a universe in 3-D film animation takes a tremendous computer dexterity and some ingenious software. There are only a handful of computer graphics companies capable of generating the quality needed by large theater screens. Right now, the field is divided among the basic four who worked on TRON: Abel and Associates, Digital Effects, Magi-SynthaVision, and Informational International, also known as Triple-I. Each company has customized hardware and software specializing in different kinds of effects.

"The field is so new," says Bill Dungan, technical director at Triple-I, "that it demands many diverse talents work together in a synchronization of skills." No combination of skills could be more diverse than those working in computer animation. During the filming of TRON, the group at Triple I included: Art Durinski, M.F.A.; Larry Malone, Industrial Design; Craig Reynolds, Computer Science; Jeremy Schwarz, Art; Mal McMullan, Mathematics; Richard Taylor, M.F.A.; and Bill Dungan, Electronic Engineering. New additions to the movie group at Triple-I include Peter Blinn, Architecture, and Kathy Fisken, Design. The eclectic field of computer graphics does not belong exclusively to the scientist.



Bill Dungan, Kathy Fisken and Art Durinski (lt. to rt.) float within a 3D computer graphic created by the Movie Group at Triple I.

graphic: Information International, Inc.
photo: Chauncey Bayes

SUPERCOMPUTERS HEAVY BITS

1.

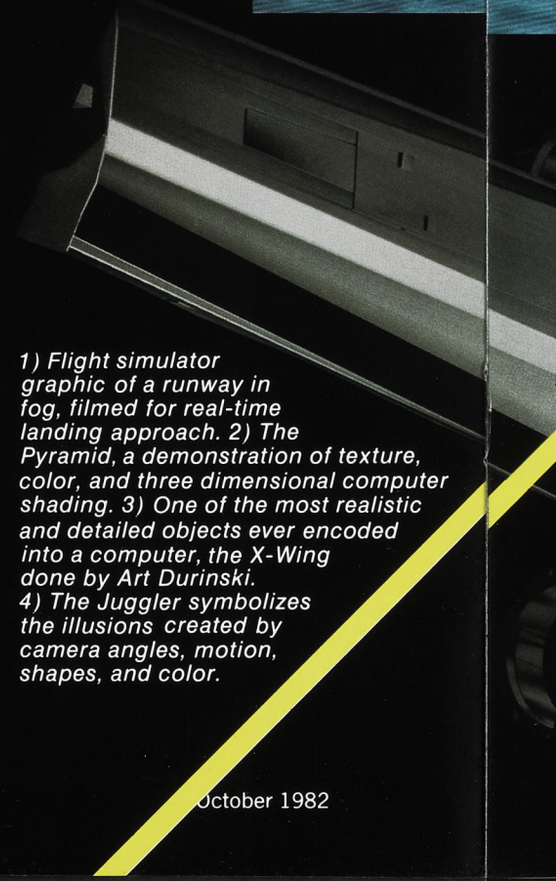
"Actually, the father of computer graphics is probably the flight simulator," said Bill Dungan, who began his work with computers at Hughes Aircraft. "After I graduated in electronic engineering, I went to work at Hughes' as technical instructor for maintenance and operations of the F-14 flight simulators. Then, I went to Technology Service Corporation to work on radar and visual simulation programs," he explained. "I was originally hired at Triple-I to design software systems for flight simulators before the TRON project came up."

While flight simulators must calculate a picture in 1/30th of a second to approximate real-time scene simulation, computer animation in the film industry can take longer on each frame to resolve the details of color, lighting, texture, and shading. These are the special effects in 3-D. Without the help of supercomputers, conventional animators using air-brushes and building miniature sets would have needed over 100 years to make the quantity of film sequences for a movie like TRON. Foonley makes it look easy.

At Triple-I a special software program, Actor Scriptor Animator Scriptor (ASAS), was developed to allow an image to translate or move from point to point and rotate on its axis from an unlimited number of camera angles. A special shading program call TRANEW creates two positionable light sources per frame. This sophisticated software adjusts the lights and shadows, giving the objects a 3-D realism as they approach or recede from the camera viewpoint.

Designed with Emitter Coupled Logic (ECL), Foonley emulates the DEC 10, except that Foonley is three times faster than the latest KL version. The magnitude of memory and speed of image generation puts Foonley in a league by himself. With a 256K word memory, where each word is 36 bits, Foonley can generate 4.5 million discrete points of color in one frame of film. The frame has a resolution of 1500 lines vertically with 3,000 points per line. Each color, red, green or blue, has a range of 512 values. With the help of a frame buffer's 512K memory, and a digital film recorder, Foonley resolves a 3-D color image on one frame within five minutes.

All things being relative in the new field of computer animation, comparison shows that if a time-sharing minicomputer could perform the feats that Foonley does, it would take about an hour to resolve each frame. Even at the rapid pace of five minutes per frame, the fifteen minutes of film animated by computers for TRON meant 1800 hours or 75 days of continuous work by the film recorder.



1) Flight simulator graphic of a runway in fog, filmed for real-time landing approach. 2) The Pyramid, a demonstration of texture, color, and three dimensional computer shading. 3) One of the most realistic and detailed objects ever encoded into a computer, the X-Wing done by Art Durinski. 4) The Juggler symbolizes the illusions created by camera angles, motion, shapes, and color.

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graphics: Information International, Inc.

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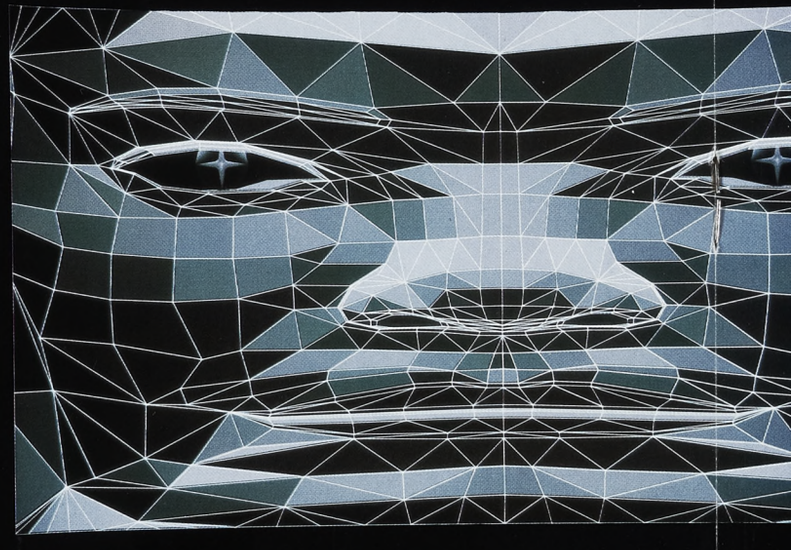
SUPERCOMPUTERS THE 4TH DIMENSION



(above) The computer-generated face of the Master Control Program from the Walt Disney movie, TRON. (right) Approaching the MCP, Information International had one of the most challenging film animation scenes in the whirling disintegration of a three dimensional cylinder-face MCP.

Creating a world of TRON inhabited by Sark's Carrier, the Solar Sailor, and the Master Control Program, required days of digitizing the objects, or encoding them on an electronic drawing board 60 inches long by 40 inches wide, through the use of a plotter. With 100 electric wires per square inch horizontally and vertically, the electronic drawing board is capable of very detailed drawings with an accuracy of 1/100th of an inch.

"The challenge in computer animation," said Art Durinski "is in four dimensional thinking. As an artist using the computer, you begin to think in terms of motion, time, sequences, and depth, as well as color and shapes." After he received his M.F.A. seven years ago, Art knocked on the door at Triple I and volunteered for any job that would let him experiment with the graphic capacities of Triple-I computers. Today, he works as art director in the movie group at Triple-I, and teaches classes at UCLA on the role and applications of computer graphics for the artist and designer. "I am trying to de-mystify the machine for the artist," he explained.

Alone, inside Foonley's dark room surrounded by tall metallic memory banks, Art plotted the X, Y and Z coordinates of an eyelash in the soft, phosphorescent glow from Foonley's visual display terminal. There was a peaceful, almost hypnotic stare on Art's face as he digitized the row of eyelashes, giving them just the right contour, lash by lash, point by point. "It is not unusual for a computer artist to work very long hours at a stretch. It's habit forming," smiled Art in the reflected glow of Foonley's display terminal.

Patience is the unsung virtue of supercomputer users. Programmers are not all that prone to patience. There are days of active combat. On those days, Foonley sits in silence and Bill Dungan circles the memory banks with taunting remarks. "I think this time the program was just too much for Foonley to handle," he would say. Or, "I think I've actually stumped him."

This is the twilight dimension to the computer world, the creative ways of handling long days with very high-powered mechanical wizards. nu

As the Computer Science Department begins a research program to measure changes in visualization skills of people using computer-aided design, Northrop University hosted an evening with state-of-the-art computer technology company, Information International.

Since TRON, Triple-I has completed a Walt Disney movie, MAGIC JOURNEYS, a television logo segment for British Channel Four, and a Simonizing Car Wax commercial. Gehring Aviation, Los Angeles, which built the motion control cameras for STAR TREK, THE MOVIE, is now marketing Triple-I's digital scene simulation services.

“The field is so new, we have to make up our own words as we go along.”

graphics: © MCMLXXXII Walt Disney Productions. Buena Vista releases.

A New Wave of Energy Enthusiasts Manage Costs and Save Barrels

EYEING THE ENERGY FUTURE

"Good morning, shields," the electronic voice booms across the desert. A few jack rabbits look up. It is dawn and one thousand eight-hundred and eighteen mirror shields face east, waiting.

Arranged in quadrants of a circle covering seventy two acres, the heliostats wait for the first beam of light to glance off their shields and hit the receiver at the top of the power tower in a blast of energy.

It is the beginning of the future solar-thermal energy industry. Fifteen miles from Barstow, California, where the average day supplies ten hours of sunlight, Solar Project One produces enough energy to power 6,000 homes.

Alone, standing three hundred feet above the desert floor, the power tower glows with a white heat capable of generating ten megawatts of electricity by converting a steady flow of water into steam at temperatures near 1,000 degrees Fahrenheit.

Built at a cost of $144 million dollars in a cooperative effort by the U.S. Department of Energy, Southern California, the L.A. Department of Water and Power, and the California Energy Commission, Solar One is a large-scale demonstration of the solar electric power available commercially within the next ten years.

Meanwhile, to handle its immediate energy problems the City of Pasadena, California sent out the call . . .

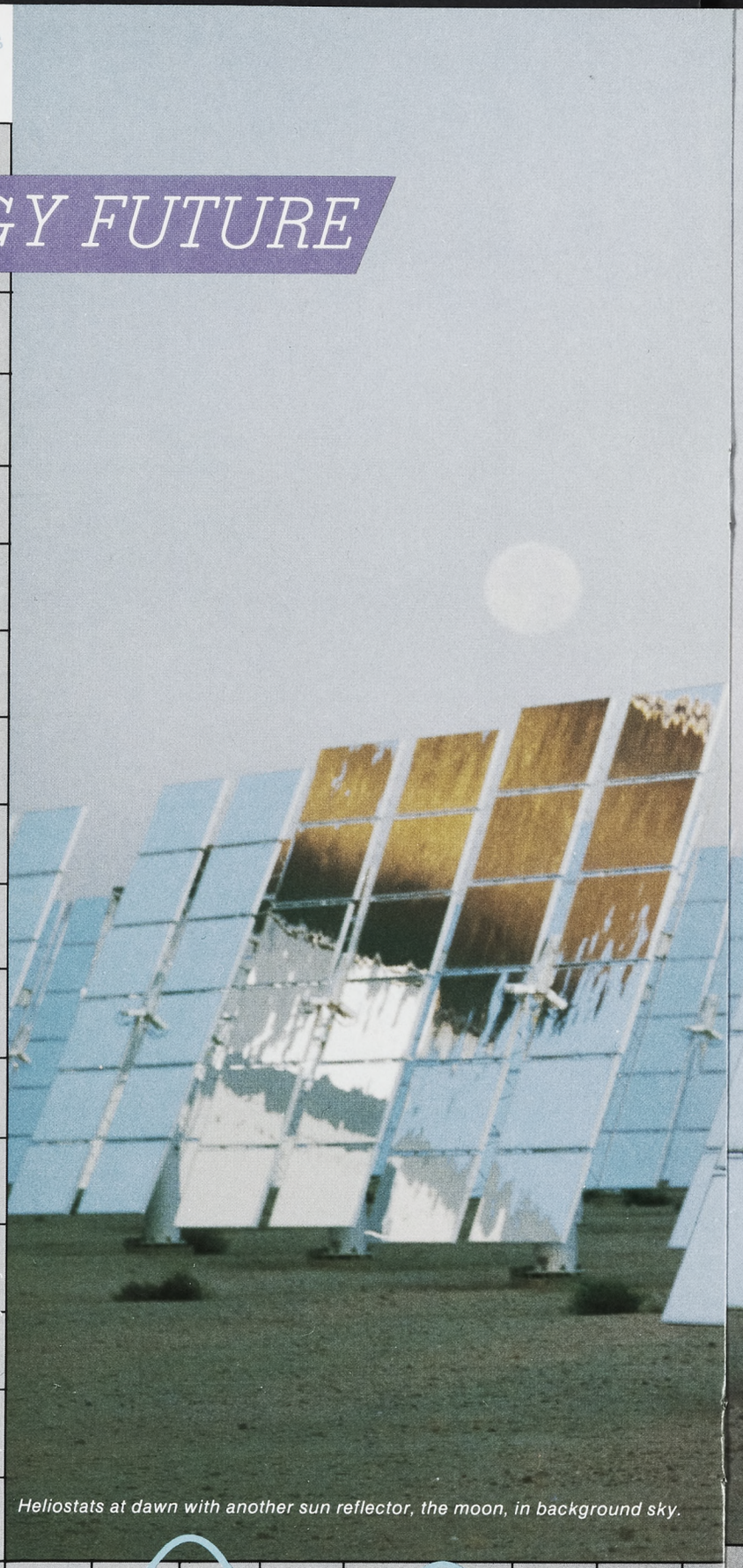
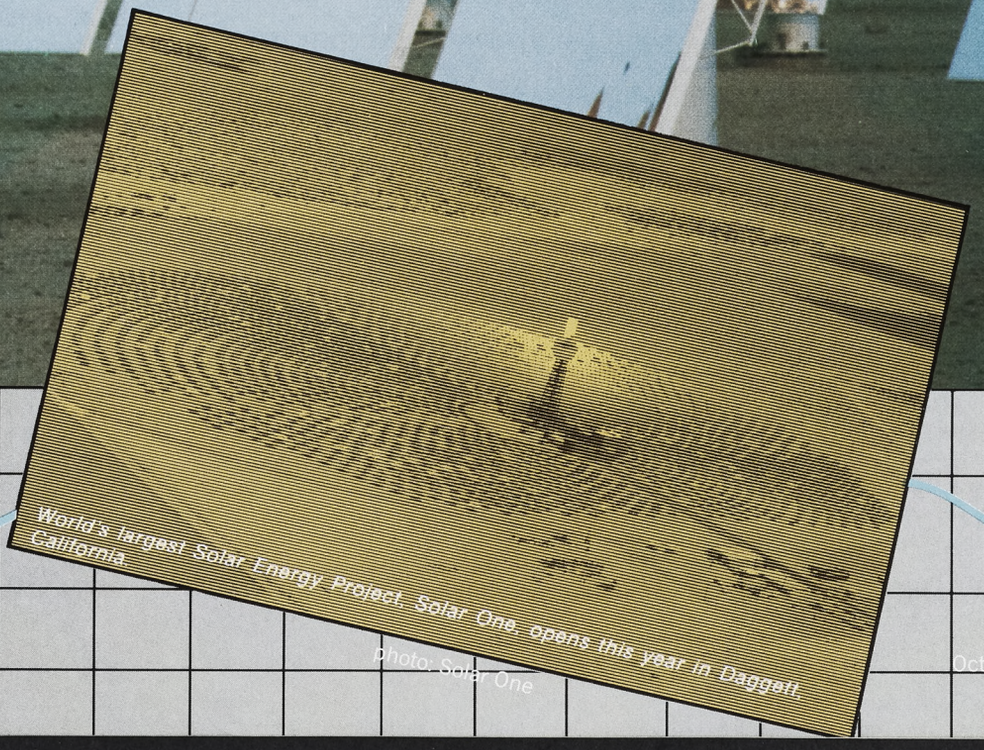


photo: Chauncey Bayes

Heliostats at dawn with another sun reflector, the moon, in background sky.



World's largest Solar Energy Project, Solar One, opens this year in Daggett, California

Photo: Solar One

A Man Who Speaks To The Future

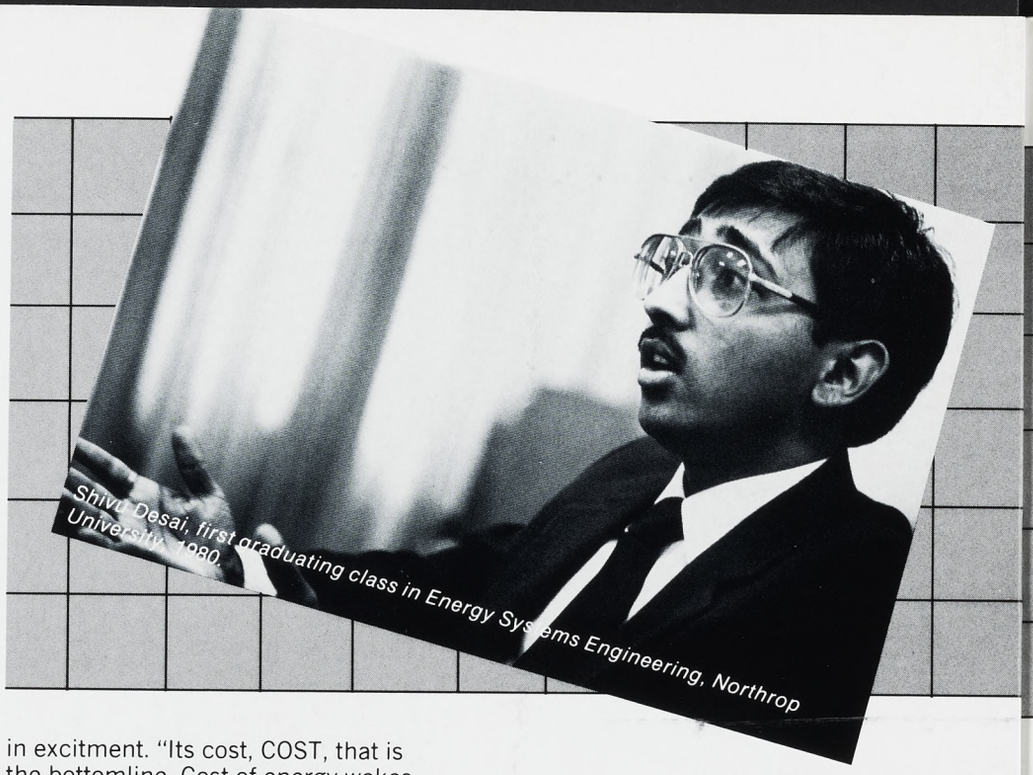
for the cheapest, safest, most productive energy alternative already available: a cost-conscious energy systems engineer. "I'm not quite as dramatic as the power tower," laughed Shivu Desai, the new Energy Coordinator for the City of Pasadena, "but I can help pace the use of energy so there will be a year 2,000."

Shivu has some stiff competition for the public's attention. Shutting off lights and putting a blanket on the hot water heater will never be a theatrical as a modern stonehenge of mirrors generating electricity in the desert. But Shivu was not hired to move mountains, just to change people's attitudes about moving them.

"Working in the energy field," he explained, "is working to change people's attitudes. Machines don't use energy. People do."

The initial handicap Shivu has to overcome is a public dread of the word 'conservation.' "People automatically think they won't be able to use their air conditioners. That's a misconception," he continued. "It's efficient use, not a blackout, we're after."

But even then, oil, gas, coal and nuclear all sound more dramatic than the word 'efficiency.' Shivu smiled. His voice and hands shot up in excitment. "Its cost, COST, that is the bottomline. Cost of energy wakes everybody up." The new Einstein equation on his desk reads "Energy = cost-conscious management." Statistics couldn't agree with him more. According to the Report of the Energy Project at the Harvard Business School, energy conservation, not alternate sources, could supply up to 40% of America's current energy usage.


Shivu Desai, first graduating class in Energy Systems Engineering, Northrop University, 1980.

To get Americans to change a habit of thinking about automatically turning off light switches, adjusting thermostats, and building with an attention to passive and active solar uses, will be the biggest job Shivu faces. He was chosen from a group of twelve finalists selected in a nationwide search for an Energy Coordinator. "We were looking for a man who could speak to the future," said Joe Callihan, director of Housing and Development for the City of Pasadena. "At 26, Shivu already had an impressive record of staying ahead of the times."

"That's why I came to this country," Shivu said. Born in the state of Gujarat, western India, and educated in England, Shivu came to the United States to study at Northrop University in 1976. He was among the first graduates in Energy Systems Engineering in 1980.

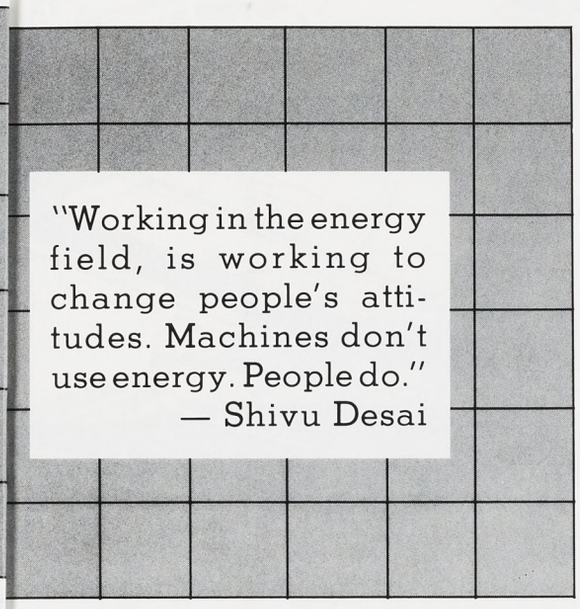
"The educational system in England is much more passive to the immediate needs of society," he explained. Somewhere in a Fluids or Math class he asked himself a very pointed question: "Is this what I want to be doing for the rest of my life?" Shivu laughed again. "I think every student should ask himself that question in high school. It made me realize that I didn't want to study to become another electronic engineer working in research. I wanted action at the forefront of a new field, so I came to the States to study Energy Systems Engineering."

Dr. David Pelka, physics professor, and his former student, Shivu Desai

> "If you want to be there when society needs you, you've got to be forward looking and take a chance."
>
> — David Pelka

A Teacher Ahead of His Time

David Pelka, the physics professor who developed the curriculum for the new energy major at Northrop University, couldn't agree more with Shivu's reasoning. "Usually, the larger educational systems are at



"Working in the energy field, is working to change people's attitudes. Machines don't use energy. People do."
— Shivu Desai

least five to ten years behind the times." he said. "They don't anticipate what will be needed. For instance, what are we turning out now? A lot of business degrees, dentists, and lawyers, Exactly the professions where there is an over-supply.'

"If you want to be there when society needs you," he continued, "you've got to be forward looking and take a change. That's where the smaller universities can help by responding quickly to future needs. They can be a vanguard."

Sitting across from each other for the first time since Shivu was a student in Dr. Pelka's class, they discussed openly the new energy sciences emerging and the role education can play in presenting them to students in time to make an impact on society. Shivu picked up an investment forecast from one of the stacks on his desk and showed his former professor the indications of growth for different energy fields. "According to this report," he said, "energy conservation will create most of the jobs in the energy fields for the next ten years. Cogeneration systems is a close second, then it will be the solar technologies. Students entering college now should consider this."

Of course being the first in a new field can present another kind of problem. When Shivu first graduated in 1980 in a field just barely known, the question was asked, "What is an energy systems engineer?" He complied with the question by developing, among other things, a Total Energy Systems Approach for 49 post offices in 10 western states. The method he originated is now widely used in the energy field.

Wedged between issues of Business Week on one side and Solar Age on the other, with stacks of product news, investment projections, building plans and city codes in between, Shivu began to explain his position.

An energy systems engineer is basically a mechanical engineer with expertise in wind, thermal, geothermal, nuclear and solar energy systems, not to mention cogeneration systems. Above all, though," Shivu paused to smile, "a good energy systems engineer must be a good communicator." That may be the key. As the City's Energy Coordinator, Shivu is centerfield. He has to interact with the State Energy Commission, the Department of Water and Power, Housing and Developent, community action groups, the school system, and most importantly, all the new developers coming into Pasadena with their multimillion dollar building plans.

Pasadena City Director of Housing, Joe Callihan, does not want to have to mandate changes. Right now, he wants to reflect an energy policy which is a service of information, education, discussion, and visible demonstration of the cost-effective uses of architectural design, solar technologies, and the rewards of cogeneration for the larger building complexes.

"Builders are very motivated to save money," Shivu began, "In fact, developers want to sit down and review their plans at a very early stage in the project to see what can be done to build energy-efficient systems into the design as soon as possible."

These structural decisions made in the beginning of a project can determine the end result of an investor's return on his money. "Buildings that are energy efficient have lower operating costs, making it easier to rent and easier to sell," Shivu explained. "For instance, just the decision about what kind of turbine generator to operate in a large building can determine from the beginning the kind of energy efficiency the final project will have."

Aside from working with the new developers, Shivu plans to influence public opinion by a three-pronged proposal to the City of Pasadena. "First, we plan to make the city facilities cost-efficient as an example to the public of what can be done to cut costs in energy use. We will do a major energy survey to audit the use of energy throughout all the city buildings, parking lots and facilties. We will make these figures public, too." he added. "Then, we will go in and change, adapting all the cost-efficient methods we can, to reduce operating costs. The public will feel the difference when they hear the savings."

Two-way communication increases energy efficiency, according to Shivu, so the City of Pasadena will be participating in neighborhood groups to find out their specific community needs and let them know what products and methods are available to solve the problems. Direct, person-to-person communication, Shivu feels, gets faster results.

The third phase of the program takes place in the school system as energy awareness programs for children. Energy fairs and summer assignments will help mobilize the future generation in energy saving activities. "It's got to become second-nature when you are growing up," says Shivu, "to flip off the switch and to think 'COST.'"

Dave Pelka explained it another way. "We have a narrow window in time. We have time to make changes, but we don't have very long. For people used to cheap energy all their lives, times of significant culture shocks are coming.

"At some point, very soon," he continued, "corporate management will return to scientific and technical leadership. It's going to take technical leadership familiar with computers, robotics, and energy systems, to effect the technology change-overs on a large-scale."

In the future age of technology, the new entrepreneurs will not be the MBA's, but the leaders with scientific knowledge, Pelka projected. "In the end, though," he smiled, "whoever controls the energy sources will have the power." nu

David Pelka, physics professor at Northrop University, met with Shivu Desai, Energy Coordinator for the City of Pasadena, and with NUANCE editor, Michelle O'Daniel, in a round-table discussion on the energy future.

SHAKEOUT in the Airline Industry

illustration: Tony Gleeson

Who will win the battle for the skies?

by R.M. Adams
Executive Vice President,
Continental Airlines

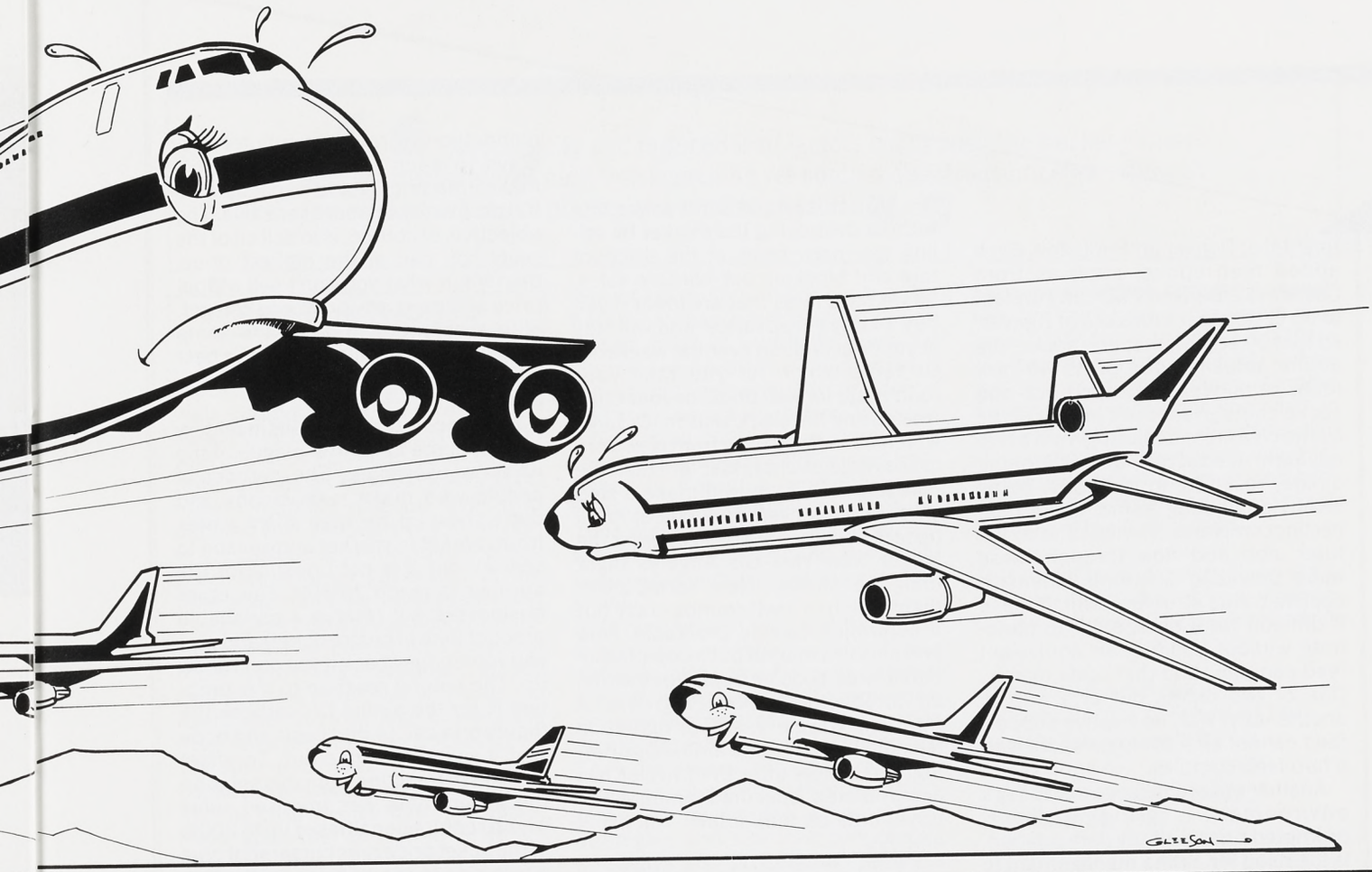
The U.S. Airline industry is close to insanity in some of its observable behavior, and it looks very bad financially. The present condition shows considerable disarray - the impregnable trunks are ill, the lowly regionals are robust. A whole new breed of commuters are springing up, and entrepreneurial new entrants abound. The number of U.S. scheduled airlines rose from 36 in 1978 to 84 in 1981. No one knows how many of them will be permanent additions to the scene. Some well known names have departed - Braniff and Laker, and Air New England. National is now part of Pan Am, and Texas International and Continental will soon be one airline. Plus, North Central and Southern became Republic, and then absorbed Hughes Air West; and Tigers and Seaboard have merged, and is now being threatened in a takeover effort.

As a group, the airlines have had a really bad three years financially. The top nine major carriers had a combined operating loss of $300 million in 1981, and would have topped $750 million derived from the divestiture of assets, notably the sale by Pan American of its Intercontinental Hotel chain. The combination of the last six months of 1981 and the first six months of 1982 have produced an overall industry operating loss in excess of $1 billion.

The second half of 1982 does not seem encouraging enough to prevent another loss year. If this estimate is born out, **the industry will have put together for the four years of 1979-82 its worst financial performance in the history of scheduled airline service. Some analysts note that these four years follow the implementation of the Airline Deregulation Act of 1978.**

There were other major factors however, including a serious and prolonged U.S. economic recession. The Air Traffic Controllers (PATCO) strike, and a long period of restricted operation following it, hampered operations, especially at the main traffic generating cities. Rapidly escalating fuel costs, from 10¢ a gallon in 1973 to $1.05 in 1981 multiplied the cost ten times to $10 billion annually making fuel into the largest single cost element in airline operations. **A one cent change in the cost per gallon has a $100 million cost impact.** Crippling interest expense rose from $335 million in 1977 to nearly a billion in 1981. Thus, with costs rising, capacity excessive, and travel down, the predictable result is the financial morass we see about us

Some of these problems are not directly within the airlines' control, such as interest rates, price of fuel, air traffic control strike. But there are areas the airlines can control directly. All airlines are concentrating on con-



> "Each airline must develop its own special niche in the marketplace to survive. This art, well practiced in other industries, is still being learned here."

trolling and reducing unit costs. In some cases this has meant fewer frills for the customer and higher density seating. In a number of cases it has meant substantial head count reductions, wage freezes, and salary cuts. A number of airlines have succeeded in working out arrangements with their unions, notably the pilots for increased productivity, more hours of work per month for the same pay. A lot of this was overdue. Under the previously government regulated environment, with competition controlled both as to where airlines could compete with each other, and as to what they could charge for their services, it was predictable that increases in labor costs would be tolerated and passed on to the customer. **The average airline employee wage rose 60% above the inflation rate in the decade of 1969 to 1979.** In the years 1977 to 1981 overall airline costs spiraled up 67.7% but airlines' fares went up only 47%. Deregulation has brought new entrants with new and frequently non-unionized labor forces and minimal capital invested, these airlines are operating at lower unit costs than the older airlines with high seniority workers, expensive union contracts, and big overhead structures including heavy investments in facilities and support equipment. The older companies must cut costs to be competitive.

The big change brought about by deregulation is in marketing strategy; where and how frequently to fly, how to control traffic flow, how to price the product, how to control the perishable inventory of seat miles, which once flown are gone - used or not.

Market Strategies

As a result of one major marketing strategy change, **route restructuring has become the vogue.** Under a regulated environment a major airline could have a linear system connecting a number of major cities, and could depend on local service and regional airlines to feed it traffic from the smaller cities to the larger ones. Now each must find his own feed traffic. The local service airlines are no longer restricted as to where they fly, and they can keep their passengers on their own aircraft and go on to other major cities. So the linear route structures are rapidly converting to hub and spoke structures, with each airline generating and keeping its own traffic - feeding it from smaller cities into large hub centers where passengers can be redistributed to other destinations on the same airline. Delta was the granddaddy of this concept with a structure that blanketed the southeast out of Atlanta. Today United has hubs at Chicago and Denver; American at Chicago and Dallas; Con-

tinental at Denver and Houston. Each added feed spoke, such as from Casper to a Denver, hub can connect to 30 or 40 other cities out of Denver, so that by adding that one spoke, the airline actually adds 30 to 40 new route pairs. Well developed hub and spoke complexes result in 70% of the traffic on a flight departing from a hub having arrived at the hub on the same airline, resulting in only 30% being locally originating traffic. Major connecting complexes of arrivals and departures ebb and flow through these hubs providing a strong defensive captive traffic structure, which make it difficult for a competitor to penetrate without building an equivalent feed complex, and that costs money. One or two flights out of a hub to another city, with no captive support feed cannot effectively compete with a hub feed complex.

Another major challenge that today's environment is bringing about, prompted principally by deregulation, is the **need for airline management** to learn to **live in an entirely different product pricing world.** Instead of selling products as a public utility might in a protected market, airlines must **now compete in a free commodity market**, much like Ivory soap, or Post Toasties, or The Readers Digest. The customer has a proliferation of choices, as to how, when, at what price he can travel from point to point.

Critical Management Problems

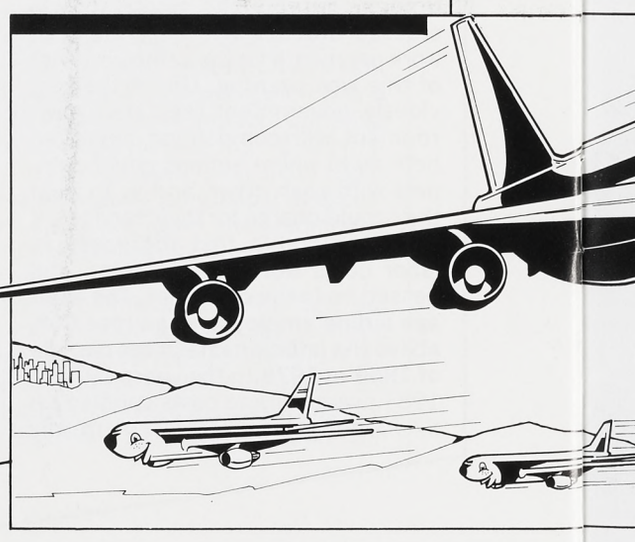
Each airline must develop **its own special niche in the marketplace to survive.** This art, well practiced in other industries, is still being learned here. The level of sophistication is growing rapidly - marketing experts are being brought in from other industries, computers are being put to work to provide new tools to analyze, understand, predict, and control pricing and to impose capacity controls on the number of seats sold at each different kind of fare on each flight. Competitive pricing is dynamic - changing day by day and depending upon an accurate reading of what the competition is doing also on a day to day, flight by flight, basis. The proliferation of different fares is bewildering, prompted by attempts to preserve higher prices for seats you know will sell, i.e., business travel, yet fill up the unused seats at some lower fare without destroying the market by selling too many seats at the discount rate and blocking out full fare sales. So we have fares that are lower if you buy 14 days in advance, and will stay at your destination over the weekend. Or fares which let you take your roommate for half price, or your child free during the slack season. Or fares which permit you to fly from New York to Los Angeles at a lesser fare than the non-stop fare if you will make a stop enroute in Denver. This one stop fill up fare becomes even cheaper for the longer New York-Los Angeles flight than the shorter New York-Denver flight which in itself sounds crazy but if controlled can be profitable. New entrants in a market put in low promotional fares, good for departures within an introductory period. Programs for frequent travelers are designed to develop loyalty to one airline by offering free tickets after the traveler has accumulated specified amounts of travel time on that airline. The list is endless.

Discounts

In 1976 about 30% of airline passengers traveled on "discount fares." Now with deregulation, that figure has more than doubled. Most travelers are on some kind of discount fare. Part of the problem with the state of the art today is that the players tend to misread each others actions because so many are new to the game and thus they react unpredictably. Since collusion between airlines on pricing is prohibited, and even frank discussion can be illegal, the whole fabric of this market is unpredictable and labeled by some observers as suicidal. Yet at least during this summer, many airlines have tried to solve the dilemma by slowly increasing ticket prices to find a balance that will produce black ink, and hoping the competition will follow suit.

An important development in the sales formula is that the per cent of seats sold through travel agents has been steadily increasing and is now over 70% for many airlines. This means your inventory of seats is on the shelf in thousands of retail stores in direct competition with all of your competitors through computer displays in each travel agency. This makes the pricing and capacity control problem even more sensitive. The objective, of course, is to sell all of the seats you can at the highest price, then fill in what you can't sell at that price at almost any price you can get. With everyone else doing the same kind of flexible selling, even the best computer programs have serious deficiencies.

Further compounding this inventory control is the long time plague of the no-show passenger. The percent of people who make reservations and don't show up for their flight varies from market to market and season to season, but it is not unusual for the number to reach 20-30%. Few other businesses will reserve a perishable product (like a theatre ticket) and give you your money back if you don't show up. The natural reaction to this problem is for the airline to overbook the flights on a calculated basis and hope that it will all balance out. To offset any abuse resulting from this solution the government has imposed rules which require penalties of up to 200% of the ticket price reimbursement plus a free ride to the original destination for the pasenger who gets caught without a seat when this overbooking practice doesn't work. A variety of solutions have been proposed to solve this problem (you would think we could just say if you don't show up you pay anyhow — your seat was there), but we have not yet been able to get the industry to agree on a procedure which the government will also approve.

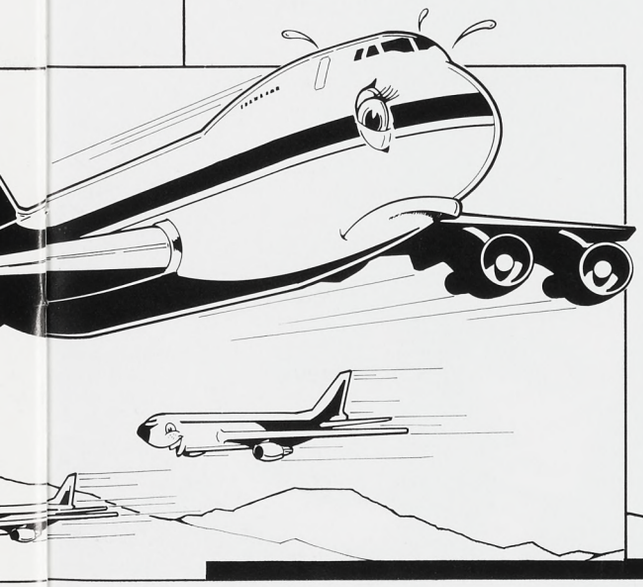


> "Overcapacity and reduced load factors could push the weaker carriers who are desperate for cash into launching yet another disastrous price war, through the suicidal misuse of pricing as a marketing tool"

Cash Flow Problems

There is another serious financial exposure which is an outgrowth of the high percentage of inventory being handled by travel agents. It has to do with cast management. Suppose you were running an Airline A with a $100 million monthly revenue level, and decided that generally a $50 million ready cash reserve should look pretty good. Revenue is generated at the time of sale, and the travel agent must forward the ticket price, less commission, to the airline within 15 days of receipt, providing a reasonably steady cash income flow. That is, unless the agent uses his privilege to write the ticket on another airline's ticket stock, say Airline B, even though he still books the passenger on your Airline A. In that case his 15 day reimbursement goes first to Airline B, which does not have to forward it to your Airline A for another 45 days. Why would the agent do this? Because he might be concerned about the financial stability of your airline, and he figures he can protect his deposit better by writing the ticket on Airline B's ticket stock. The result is a deferral of cash flow to your Airline A of 45 days. If half the agencies suddenly felt this way as a result of an unfavorable story in the business press, for an airline with $100 million monthly revenue, the impact would be a gap in the cash flow of up to $50 million — and the $40-50 million cash cushion which looked good is suddenly gone. Of course, the problem is even worse if the agents lose enough confidence that they do not even book on your airline at all. Suddenly working cash reserves evaporate. This is what happened to Braniff — and they went bankrupt with almost no warning. Thus public and travel agent perception of the airlines financial stability becomes a critical management responsibility.

So here we are today, with airlines in a complex montage — some new entrants, and some formerly regional airlines doing very well, some new entrants and most of the trunk airlines facing serious financial challenges. They are concentrating on reducing costs, on changing their route structures, on developing saner pricing strategies, and seat inventory control strategies and procedures, paying a lot of attention to cash management, and wishing they could solve the no-show problems. How does all this seem to be working out?



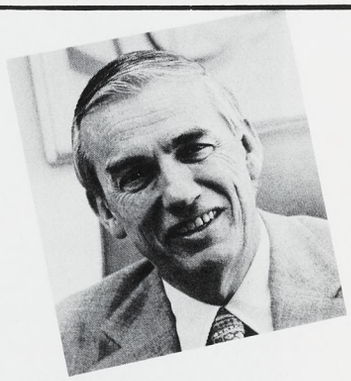
Is There a Winner?

In the fall of 1982, the picture is not yet clear. The first quarter of 1982 was a financial disaster with nearly a $500 million loss. The second quarter was better, but the industry still lost $161.9 million from operations after interest. There is every indication that the industry will make a small profit in the third quarter, normally the time when the industry makes its major profits to cover the year.

The industry faces a critical fork in the path. Loads traditionally fall off after Labor Day but they are doing so to a greater extent than most airlines expected. **The resultant overcapacity and lowered load factors could push the weaker carriers who are desperate for cash into choosing the path of launching yet another disastrous price war, through the suicidal misuse of pricing as a marketing tool. A serious price war this winter would certainly bring more airline company casualties.** We may have some losers anyhow. That's the bad news. But there will be some winners. These will be the best managed airlines. Another winner is the consumer who has had unprecedented travel bargains and will continue to have good value for his airlines ticket dollar as competition forces prices and services to seek the level of the public need.

The character and composition of the air transport industry may change, but it will survive. The public needs it.

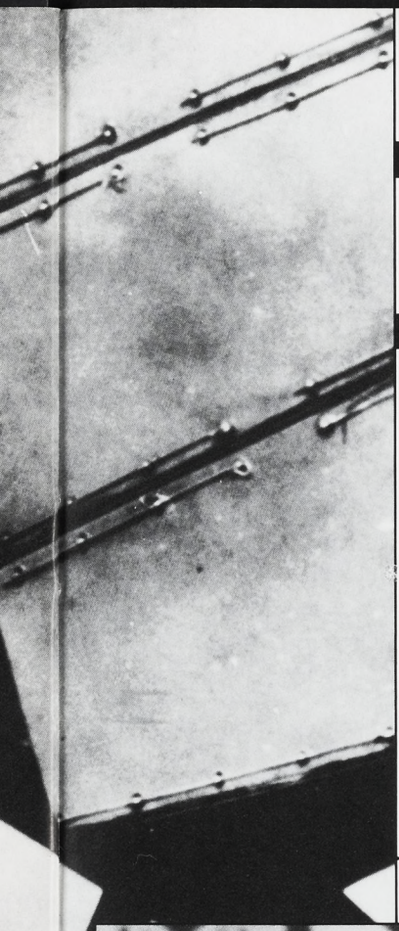
From a speech delivered at:
Northrop University School of Law
Aviation Symposium '82
Deregulation &
The Airline Industry Today
September 24, 1982



Richard Adams
Richard Adams is Executive Vice-President, Operating and Technical Services for Continental Airlines and a member of the company's Board of Directors. Adams began his aviation career with Pan American World Airways in 1940 and over the next 22 years, he rose through the ranks of Pan American to the post of manager of maintenance and engineering for the overseas division. In 1962, he joined Continental as Vice President, engineering and maintenance. Mr. Adams received his Bachelor's degree in Aeronautical Engineering from the University of Michigan, and completed the Graduate School of Management's Executive Program at the University of California at Los Angeles.

historical photos: American Hall of Aviation History

DOOLITTLE



An Interview
with
James H. Doolittle

By Michelle O'Daniel

(left) Doolittle as salesman for Curtiss-Wright in South America, late 1920's. (above) Lt. Gen. James H. Doolittle, (ret.) at age 86 on visit to Northrop University.

Very few men fly through waves of future shock as often as James H. Doolittle. He was the man out in front of the changes in aviation. "It's easier to lead that way," he said, looking back over his 86 years. "The easiest way to get a 'followship' is to personally lead."

As Commanding General of four strategic Air Force divisions in North Africa, Italy, England and Okinawa during WWII, 'Jimmie' Doolittle personally led his missions. The most famous was the surprise Tokyo Raid in 1942, where he led 15 B-25's from the deck of the U.S. carrier 'Hornet'. This bombing mission over industrial Japan would demonstrate American air power and trigger the Battle of Midway.

Usually the Doolittle intuition is right about which way leads to the future. Daring, 'daredevil Doolittle,' took aviation from seat-of-the-pants flying to scientific instrumentation and engineering. Before the Air Force was created, before airports, before instrument flying, or strategy bombing in air warfare, or even long distance flying were ever thought possible, 'Jimmie' Doolittle was experimenting with the possibilities.

When wars were still fought at sea, Doolittle signalled the age of civil and military air power. In 1922, he made the first transcontinental flight, a distance of 2,163 miles, alone in a DH-4 in 21 hours and 19 minutes, proving the long-distance possibilities of flight for both cargo and passengers.

As early at 1933, Doolittle stood up as a minority of one defending the development of an independent Air Force to the Baker Board of the Army Air Corps Investigating Committee. "I believe in aviation" he said, in 1933, "both military and civil. I believe that the future security of our Nation depends upon an adequate Air Force." Ten years later, with the example of the Luftwaffe in the air, Doolittle was no longer a minority.

With a combination of "fearlessness and skill," as the citation for the Distinguished Flying Cross read, Doolittle managed to execute the first 'outside loop' in 1927, and to make the first 'blind flight' under instruments in 1929. Working with Elmer Sperry Sr. and Jr., he helped develop the Sperry Artificial Horizon and Directional Gyroscope for flying safely in all kinds of weather.

At age 28, Dr. James Doolittle became one of the first in the world to be awarded a Doctor of Science degree in the new field of aeronautical engineering. He was one of six students selected by the Army to receive an education at M.I.T. His thesis covered a subject still widely discussed, "The Effects of Wind-Velocity Gradient" expecially on heavily-loaded aircraft very near the ground.

In the history of aviation, very few tested as many limits as James H. Doolittle. One step at a time, he helped map the skies. Visiting Northrop University on the occasion of its 40th Anniversary, Doolittle discussed his episodes in aviation.

Nuance: Did you contribute to the separation of the Army Air Corp and the Air Force?

Doolittle: Billy Mitchell was the prophet. He said there were three media in which to operate: water, land and air. All of us who believed in the future of aviation, were "prophets" of Billy Mitchell. And so, yes, I worked very actively for many years to form a separate Air Force, as distinct from the Army and the Navy. The Navy has its own complete service — they have the Navy ships for the seas, they have the Navy planes for the air, and they have the Navy ground troops in the form of the Marines. So the Navy is unique in that it has all three services. The Army also has such aviation as is necessary to directly support the Army, and the Air Force has the chore of helping wherever it can, but its primary duty is strategic air.

Nuance: What other contributions to the forming of a separate Air Force did you make?

Doolittle: I was one of the voices. Now, I did take a more active part immediately after we had our Air Force, and that was the formulation of the Air Force Association, of which I was the first president.

Nuance: What are your personal feelings about the man — General Hap Arnold?

Doolittle: Well, I first met Hap Arnold immediately after World War I. I was stationed at Rockwell Field. This was late '18 just after the WWI. Colonel Arnold came to Rockwell Field to command. I have been one of his disciples, as I was one of Billy Mitchell's ever since. We were all working for a separate Air Force.

Nuance: What was Hap Arnold like?

Doolittle: He was a very dedicated person. He had outstanding capabilities or he would never have achieved five stars.

Nuance: How well did you know him?

Doolittle: I considered myself one of his boys. He was, I believe, nine years older that I am, but I knew him in 1918 until he died. I was very close to him. It was he who took me into a rather unusual situation.

I had never commanded anything greater than a squadron when I was put in command of the Twelfth Air Force in North Africa. He had great confidence in me, and of course, he was one of my idols.

Nuance: How hard did you really have to work on the Tokyo Mission? How strenuous was it to get those planes off the deck of the 'Hornet'?

Doolittle: I was given the job of selecting and supervising the training of the crews, and selecting and supervising the modifications of the equipment.

At the same time, I trained with the boys to achieve skill and carrier take-off technique which is somewhat different from taking off from land.

Nuance: Were you 46 years old at that time?

Doolittle: I was born in December of 1896, so I was 45 during the Tokyo Raid.

Nuance: Was there ever a time in the preparation of the mission when you thought 'this is too much, or this is too strenuous?'

Doolittle: There was never the least problem because we were given 'first priority.' We had priority over all other military operations, and when you have top priority, you can move mountains. If I wanted anything I asked for it. Several people said I couldn't have it, and then I immediately showed my top priority, and I would have it.

So, when you are given a job to do, and you are given top priority, almost any job becomes comparatively easy. If you are bucking all the other forces that want the equipment, want the people, and so forth, then you have a much more difficult job. So it was a relatively easy job simply because of top priority.

Nuance: Did you contribute to the study for the planning of airports across the United States?

Doolittle: Yes. President Truman appointed a committee to make a study of airports. I was the chairman. It was called the Doolittle Committee and the outcome was a booklet entitled, "The Airport and its Neighbors." It has been pretty much the Bible for new airports for many years.

One of the recommendations that we made was not to build an airport in the immediate vicinity of a lot of people. It should be out, far enough away, so that you can avoid the inherent noise and nuisance an airport causes. We recommended that a considerable V-shaped area be devoid of housing where the airplanes came in and where the airplanes went out. The fact that this recommendation was never really considered with sufficient seriousness is a reason for much of the trouble the airports are in today.

Nuance: You have said you wouldn't like to live your life over again because you might not be as lucky.

Doolittle: I feel that I have been extremely fortunate. There are so many things that could have gone wrong, and didn't, and I, indeed, would not want to live my life over again because I am sure I could never get all the good fortune twice in a row that I have had.

A 1930 portrait of Doolittle as leading aviator for Shell Oi world racing records and made famous "Shell speed

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> **"I think one of the greatest attributes of leadership is to be able to instill "followship" . . . and, of course, the easiest way to do this is when you lead personally."**

Nuance: You mean in the aircraft?

Doolittle: I mean in everything. Matter of fact, I would never again have an opportunity a second time around to marry a lady as lovely as my lady.

Nuance: Whenever you talk about yourself you mention your wife, Joe.

Doolittle: We were school-day sweethearts here in Los Angeles. She was a southern girl, and spoke with quite a decisive accent. She was a nice little girl. I was a naughty little boy. I didn't see any real future in nice little girls, but when we were in our senior year, I knew then that this was the girl for me, and so I proposed to her, admitting that there would be a slight hiatus before I made my first million.

I promised if she would marry me, I would take her on the most beautiful trip in the world, and that was up the 'Inside Passage' to Alaska. I had spent eight years in Alaska as a youngster. I made that promise in 1913. We were married in 1917, and in 1973, I'll admit there was a hiatus of sixty years, but I did take her up the 'Inside Passage' to Alaska which indicates two things: one, girls should be patient; and two, husbands are dependable.

Nuance: In talking about people in general, what makes leaders?

Doolittle: I think there are two basic things to a leader — first, you must know what you are trying to accomplish and have an appreciation of the importance of that accomplishment.

I think one of the greatest attributes of leadership is to be able to instill "followship", to be able to impress people with the belief that you are knowledgeable enough for them to follow you. And, of course, the easiest way to do this is when you lead personally. I found that in North Africa and in Italy, where I led 27 missions, it was very easy when I said, 'Follow me, fellows.' I got their immediate respect.

Nuance: How much of you is the thoughtful, planning and dedicated person, and how much is the dare-devil?

Doolittle: I think there has been a transition through the 86 years that I have been aboard. I am afraid that in the early days there was some mischief, dare-devil, if you will, but as time went on, I became the more careful planner, and hopefully, the skilled executor.

Nuance: When you were experimenting with aviation as everyone else was, did you realize its implications, or were you just toying with something that was just fascinating to you?

Doolittle: In the very early days, then it was a fascinating thing — tremendously interesting. But as time went on, one began to see the value and potentialities and, what can I say, the fact that you can be a servant of the human race in advancing aviation.

Nuance: How were you able to see the future of aviation?

Doolittle: It may take a minute to talk about that. I was in the service in 1917 as a Flying Cadet. I was then commissioned and became a reserve officer in the aviation section of the Signal Corp., —and then, the Air Service — and then, I went into the regular Army Air Service. In 1930, my mother was ill. My wife's mother was ill. My wife's father and my father were gone, and we, on a first lieutenant's pay, could no longer meet our filial obligations. So, I got out of the service and went into the Reserves, and was immediately promoted to Major.

Then, I went with Shell Oil at three times my military salary.

Just at this time, we were beginning to realize in this country that air transport was going to be a very important thing. Up to that time, it hadn't been. But in the late '20's it became very obvious that aviation was going to be important.

All of the oil companies hired an Army or a Navy aviator as the head of their aviation department. Texaco hired Frank Hawk. Gulf hired Al Williams. Standard of New York hired Buzz Aldrin's dad, Eddie Aldrin. Shell hired a chap named John McCready who was a very fine aviator and test pilot. There were three Shell oil companies at that time in the United States, and John invited me to take over the aviation department for one of them. Finally they put them all under one head, and I became head of all the aviation departments of Shell. So, for ten years, I went to Europe every other year to coordinate the aviation developments of the Shell Oil Company.

At that time, Ernest Udet was a particular buddy of mine. He was a very famous World War I fighter ace. He and Goering, I guess, were the two top. I never met Goering. But Udet turned his airplane and his pilot over to me and said to the pilot "Take him to all the plants that are building aircraft and engines in Germany." And for the first time, I had a realization of what was going on. Germany was preparing. This was 1937. They had completely violated all the agreements made at the Treaty of Versailles. I went over again in 1939. This time they showed me nothing. Udet invited me to go to Munich with him, he was going on a two-week's holiday, and I didn't go because I thought I might be spying on one of my best friends.

I reported what I had seen to General Arnold in '37, so he was apprised of all that. Then, I reported to him on the new change, and the fact that I was convinced that war was imminent, because they told me nothing, showed me nothing — even lied to me in 1939.

There was a whole bunch of finished lumber in a great pile obviously for underground storing, and so I asked, "What is this?, and they said, "Oh, that is pulp wood. We are going to make paper out of it." It was such an obvious lie.

So, I came back again, and reported what was happening to Hap Arnold, and said "I feel war is imminent. I think there is a good chance we would become involved. I would like to offer my services full-time,

Colonel Doolittle with air crew on board USS HORNET ready for famous raid over Tokyo in 1942. "I remember the moment well," said the General , today, "We tied the previously awarded Japanese medals to our 500 pound bombs and thought we would return them special delivery."

part-time, in uniform, out of uniform, any way you can use my services.' The day after Pearl Harbor, he called me and said, "I want you on my staff. How soon can you get here?" I said, 'Well, will tomorrow be soon enough?' He said "Yes, just." So that is how I inherited the job of preparing the aircraft and the pilots for the Tokyo raid.

That's a long preamble, but I had a very different opinion from Lindburgh and Al Williams, both dear friends, who had been briefed by Goering, at the same time I was being briefed by Udet. They came back, both convinced that war was going to take place and that Germany was invincible.

Lindburgh, of course, was from the north central part of the country where our isolationist people are strongest, and he did not believe that we should become involved in any foreign activities. Roosevelt felt, and was convinced, that we would inevitably be drawn in. Therefore, the sooner we were drawn in, the more effectively we could help defeat Germany.

Of course, you may remember that Roosevelt was very angry with Lindburgh. When we declared war, Lindburgh offered his services, and the President wouldn't let him join in. So, neither Lindburgh nor Williams were permitted to come back on military status because they had defied the President.
What actually did happen was that Lindburgh, then in civilian status, went to Detroit and helped reorganize the automobile industry into the manufacture of aircraft, giving them his knowledge and techniques. He even went to the Pacific and flew missions teaching the boys how to preserve fuel and lengthen their cruising range. He shot down some Japanese too. He would have been immediately destroyed had the Japanese captured him. So he did, despite the fact that he had earned the President's antipathy, everything he could to be helpful.

Nuance: What was the last plane you piloted?

Doolittle: I wanted to say that after the war, I went back on reserve status, and as a matter of fact, I was the only reserve officer in any service to achieve three star rank. At that time, I flew the first supersonic fighter — the F-100 — I flew the KC-135 which was the tanker, and I flew the B-47 and the B-52, and then never flew as first pilot again.

Nuance: What made flying become such an obsession?

Doolittle: If we're going to bake the best bread in the world, I think that could be done, and it could be interesting but there isn't the thrill about an oven as there is about an airplane. There isn't the same thrill in a kitchen as there is in all outdoors.

Nuance: Did growing up in Alaska instill in you the spirit of adventure?

Doolittle: In Alaska, I had a feeling of being circumscribed, surrounded. There wasn't much of any place to go, there wasn't much of anything to do. I think that was what instilled in me the desire to see the world and to do unusual things — interesting things.

I knew when I was very small, that I was going to see the world and I was going to build things. My dad was a carpenter. He taught me how to use tools, and I knew that I was going to be an engineer. There were two kinds of engineers who went all over the world — one was the civil engineer, who went all over the world building bridges, dams, highways; the other was the mining engineer who went all over the world looking for oil deposits and recovering the ore. I decided I would be a mining engineer. I was studying engineering when World War I came about, and it was then that I changed from underground to above-ground. I became an aeronautical engineer.

Nuance: And you went to M.I.T. The Army chose you?

Doolittle: At that time there were very few highly technical people in uniform, and the Army felt that it was desireable to train some Army people so that they were not entirely dependent on people outside the Army for the technical advice and

Two friends: Major General James H. Doolittle, 1944, commander of the Eighth Air Force, alongside Major General George S. Patton, Jr..

> **"I was the smallest kid in school and I learned to take care of myself quite well because every new kid who came into town had to whip me before he could whip any bigger boys, and so, in the use of my hands, I became quite adroit."**

the work they they wanted done. So there was a group of us sent through the Army at that time at an aeronautical engineering school — one year course — and there was about eight in the group that went through that school every year. Then when my group came along, I think I was in the third group, I not sure, they decided to send some of us to M.I.T. and I was fortunate to be one of those chosen to go. There I took a Masters and a Doctorate in Aeronautical Engineering.

Nuance: Who were your heroes? You probably had people that you really feel were influential or that inspired you?

Doolittle: Whether you achieve your goals depends upon two things — your inherent capabilities, and the effort you are willing to make to achieve them.
At a very young age, I wanted to achieve excellence in whatever I did. I can remember being the smallest boy in town in Nome, Alaska. I was the smallest kid in school, and I learned to take care of myself quite well because every new kid who came into town had to whip me before he could whip any bigger boys, and so, in the use of my hands, I became quite adroit.

Nuance: But did you have personal heroes?

Doolittle: Yes. Scotty Allen was a dog-team driver, and he usually won the dog-team races. He also won the indoor races. In those days in Nome in the winter-time you didn't run outdoors, you ran in an indoor gymnasium. He usually won them. There again, I think anyone who has a desire to excel, which I did, even then, fix people who have achieved excellence in whatever they are doing, and they became your mentors to a degree that you can get them to help you, or to the degree that you want to emulate them.

Nuance: If you had to lose all modesty, what are you most proud of?

Doolittle: I have never tried to distinguish the different things. I think one of the useful things that I did was to develop the science, the equipment and skill necessary to fly aircraft in any sort of weather. That work was financed by the Guggenheim Foundation. I was very happy to have been selected as the chap to develop the equipment and technique necessary and I did this in 1929. I made the first take-off and landing under a hood without ever having seen the outside of the airplane.

Nuance: Just by instruments?

Doolittle: I think the development of the instrumentation, the technique and the skill necessary to fly by instruments was probably the most useful thing that I ever did.

Nuance: If you were a young person today starting all over, what field do you see as the challenge?

Doolittle: Of course space continues where aviation left off. You hardly see the change.
I was the last chairman of the old N.A.C.A. before it became N.A.S.A. We, at that time, had a budget of about $100,000,000 dollars per year, part of which even then, was used in the development of concepts in connection with space. The $100,000,000 rapidly went to $2 billion as we became interested in space.

So, I have seen aviation develop, and I have seen the start of space developing from it — that is, I was a part of the development of aviation, and then a part of the next step which was starting to use some of the facilities, some of the people, some of the money, to go into space. So I feel that I was associated with it in the early days.

Nuance: Personally, when you were on the Tokyo mission, did you think it was going to be a kamakazi mission?

Doolittle: No. When you have a mission of that kind, you prepare yourself as best you can, consider every eventuality and have a plan to cope with that eventuality. If you are doing that, really there is no time for fear. If you were just sitting there, and doing nothing physically or mentally, then it seems to me it would be easy to get perturbed. But when you are utilizing every speck of brain power in order to accomplish a purpose, there is no time left for fear. nu

To Keep 'em Flying

Chances are, nobody remembers the name of Lindbergh's mechanic, the man who stayed on the ground. Headlines in aviation were made by the men in the air. Wherever the pilot and his biplane flew, they made news. They became the war heroes, the stuntmen, the "aces", movie stars, and the new explorers. And when they flew the early 'strut and bailing wire' planes out over the landlocked farms and across the central United States, they won the imaginations of the nineteen and twenty year-olds who left the family farm, or dropped out of pre-med school, or got out of the service, and came to California in the late 30's to learn about aviation.

Many of them became the hangar men who built the wooden airframes, stretched and sewed the fabric skins over the wings, fixed the wiring, and learned to fly on weekends. Sometimes they worked for .49 cents an hour learning to install Curtis Electric propellers and reading the manuals on powerplants.

There were those who left the farm, sold their life insurance policy, drove west to Los Angeles, and washed dishes at night to pay for training as an aircraft mechanic. Most of those twenty year-olds working on WACO's and Fleets, flying on weekends and building their own aircraft, found some way to stay in aviation all their lives.

In 1930, when Charlie Dietrich graduated from high school in Swedesboro, New Jersey, the first coast-to-coast commercial airservice began regular flights between New York and California. During the next year, as Tony Vai graduated from high school in Illinois, aviation witnessed the first flight of a full-sized, jet-powered aircraft, the Italian OMNIADIR. That same year, international airservice stepped up with the entry of the four engine airliner, the famous Handley Page HP-42, into the British Imperial Airways. Tex Hilley was still going to high school and reading the headlines from the farm in the west Texas border country.

Charlie, Tony and Tex all watched the biplanes come in low over the farms and disappear into the distance. The 30's were bad times for ambitious twenty-year olds to think about becoming farmers. They were curious to find out where the low-flying Jenny's and DeHavilland's were going.

(Continued)

During Northrop University's 40th Anniversary year, Tex Hilley, Charlie Dietrich and Tony Vai also commemorate forty years in aviation and education. They all began by working on the silver-winged Fleet.

. illustration: Michael Haasis

NORTHROP
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To the young men in Illinois, New Jersey, and west Texas, the advertisement in a 1938 AIR RACES magazine summed up the spirit: "ARE YOU STANDING ON THE SIDELINES OF AVIATION?" it read. "GET INTO THE PICTURE IN CALIFORNIA. LEARN HOW TO DESIGN, BUILD, AND MAINTAIN TODAY'S GREAT PLANES." Tex, Tony, and Charlie all read that ad. They also read the column across from the ad which announced the transcontinental speed records of private aircraft in 1938. Beechcraft was the leader with a Wright 420 engine, averaging 166 mph from New York to Los Angeles for a total flight time of 14 hours and 55 min. The Lockheed airship followed second with a Pratt and Whitney Wasp clocking into Los Angeles in 15 hours and 39 minutes.

It took Charlie Dietrich eight days to drive his 1938 Plymouth from New Jersey to Los Angeles. He cashed in a life insurance policy and enrolled in the California Flyers' School of Aeronautics at the Los Angeles Municipal Airport for the $500 one-year Master Mechanics course. Tony Vai was already enrolled there teaching part-time in welding and "Engine and Airplane Theory" for $6 a week plus one hour flying time on weekends. Tex Hilley arrived at California Flyers' from west Texas just as soon as he convinced his father he was not cut out to be a doctor. "Dad, and everybody else, knew you could lose your shirt in aviation," Tex recalled. "But there was nothing rational about it. All I wanted was to be a pilot. Maybe it had something to do with growing up on a farm out in west Texas country and watching my uncle fly down to visit in a W.W.I 'Jenny', stay for supper, and they fly off again."

If you didn't have enough money to become a pilot right away, the next best thing was to work with aircraft to keep them flying. Tex entered California Flyers' School of Aeronautics, washed dishes at night, worked odd-jobs Saturday, and became the private mechanic on a tempermental Dusenberg. "That Dusenberg got me through school," he said. "Apparently, I was the only one who figured out that it needed a long, fast run to clean out the carburetor from time to time. So, once a month I raced it down the coast. It ran like a dream and I made $500.", Tex grinned.

By 1941, all three were certified Master Mechanics in aircraft maintenance, just as aviation geared up for military aircraft production and commercial airliners. Charlie Dietrich got a job with North American for .49 cents an hour installing propellers and engines on Harvard AT-6's, Mitchell B-25's and Mustang P-51's. At night, he read the manuals on powerplants and taught himself enough to pass the FAA certificate for powerplant maintenance. In 1942 production of the DC-4, the four engine long-range airliner which would change commercial aviation, began to be mass produced and Tony Vai was foreman of the sub-assemblies manufactured at Cal Flyers.

That same year saw the first flight of an American jet aeroplane, the Bell XB-59A, with two G.E. engines. Aviation was opening up. A few miles east of the LAX, in Hawthorne, California, John Northrop and James McKinley started Northrop Aeronautical Institute as a technical training division of Northrop Aircraft. Eventually, California Flyers' School of Aeronautics and Northrop Aeronautical Institute would merge, but not until Tony, Tex, Charlie and five other friends, had bought out the name and assets of Cal Flyers.

The three young men from Illinois, New Jersey, and west Texas, incorporated their own aircraft mechanics training school and manufacturing company in September 1946. For awhile, they picked up a paycheck of .98 cents a month, working at odd jobs in the evenings and on weekends, just to keep the school running. When the G.I. Bill went through, veterans enrolled in the aircraft maintenance program and Cal Flyers was running day and night classes for 1,400 students. When the vet program started to run out in 1950, they converted the evening shift to manufacturing and worked two eight-hour shifts a day, teaching and manufacturing.

By 1953, Cal Flyers was mainly manufacturing aircraft parts. The student enrollment had dropped below 200. Just at that time, Northrop Aircraft decided to divest itself of its interest in Northrop Aeronautical Institute and James McKinley, as its co-founder and technical director began looking for a new location with enough space and equipment. California Flyers' had the facilities. Northrop Aeronautical Institute had the students.

(left) Cal Flyers School of Aernautics at Mines Field, later Los Angeles Municipal Airport, 1939. (above) Tex Hilley and the Beech Bonanza. (below) Charlie Dietrich with students at Northrop Aeronautical Institute in 1952.

In 1953, they merged to form what is known today as Northrop University's Institute of Technology. It remained Northrop Aeronautical Institute until 1956 when it was granted non-profit status and became Northrop Institute of Technology. At that time, Tony Vai was appointed Director of the Aviation Technician School, a position he held for twenty years.

During those years, Tony Vai helped define and develop aviation technician education. He was twice elected president of the Aviation Technician Education Council (ATEC) which has a membership of most all the 148 FAA-approved aviation and powerplant schools in the United States. He also became a charter member of the California Aerospace Education Association (CAEA), and in 1966 served on their National Advisory Committee working to advance and improve aviation technician education.

Over the years, Tony built an aviation technician program as carefully researched and well-planned as the surface area of an air foil. He was awarded the California Aerospace Education Association's highest honor, the Paul Mantz Award.

Under his guidance, Northrop Institute of Technology expanded the options for aviation technicians in the avionics programs, helicopter maintenance programs, and in an airframe and powerplant certificate program which could be transferred to a Bachelor of Science degree program in the University's College of Engineering Technology.

Back in 1949, with the help of Tex Hilley, Northrop Institute could boast a J-47, one of the first running jet engines, ever to be assembled on a campus. By 1952, Tex set up one of the first turbine engine courses in the United States. Today, he teaches "Engines B", the overhaul and repair of live piston engines that will, as he says, "fly again."

Charlie Dietrich taught for 35 years at Northrop University's Institute of Technology. Records show he missed three days work in 35 years. He taught the crucial last phase of the program, the review and test of all the airframe and powerplant courses. Since 1950, when he became an FAA Mechanic examiner, he has personally administered a record breaking 5,000 FAA oral and practical exams, free of charge. To this day, he still has every name and every score of every student he tested.

Surprisingly, when Charlie retired in 1982, Tony pulled out his own black record book from the days he taught "Airplane and Engine Theory" at Cal Flyers. Charlie's name and test scores were still there. So were Tex Hilley's in the same 9 a.m. class in 1939.

The twenty year-olds from Illinois, New Jersey, and west Texas found a way to work in aviation for over forty years. They were among the first educators in aviation technician training. Charlie still administers the FAA exams. Tony Vai keeps his office on campus, and attends A&P graduations when he isn't visiting one of his 15,000 former students from 100 different countries.

Tex still flies on weekends, this time in his own red Beech Bonanza. Weekdays, he is in the Engine Shop teaching twenty year-olds how to make a 1974 Lycoming engine from a Beech Queen sound as good as the engine next to it, the Curtis OX-5, 90 hp, which is still airworthy and running steady as the one in the Jenny his uncle flew over the farm in 1922.

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